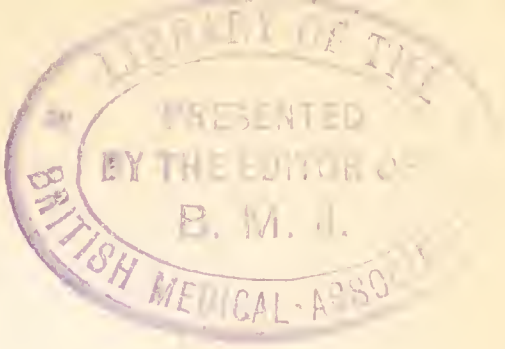
THE PERSONAL EQUATION

LOUIS BERMAN



By courtesy of Rudolph Lesch

THE DWARF DON ANTONIO, BY VELASQUEZ

An effect of pituitary gland deficiency

THE PERSONAL EQUATION

BY

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"The living being is a chemical mechanism and perhaps it is nothing more."—RICHET.

"Conviction that science alone is able to redress the disharmonies of the human constitution will lead directly to the improvement of education and to the solidarity of mankind."—METCHNIKOFF.

FOREWORD

We are, fortunately, beginning to realize that what we think of as mind is so intimately associated with what we call body that one cannot be understood apart from the other. Bodily reactions to emotional states are well recognized, and the "unconscious" is probably but the domain, as yet poorly explored, of physiological changes which have escaped our notice. Hidden impulses, repressed desires, not always improper ones either, in conflict with inherent instincts influence conscious thought and physical fitness tremendously. We are apparently unaware of a great part of what we perceive, remember, will, or infer. "The brain is the organ of forgetfulness as well as of memory," and the forgotten or the habitual constitute a great part of the so-called "unconscious," a psychic state which far outruns in activity our conscious being. It cannot be denied that physicians scientifically trained in the investigation of special organs or functions take too little note of the emotional and mental reactions, making the actions of the human body as a unit. Until the study of human behaviour and the personality factor becomes more animated and consistent a lack of logical motive in the work of many physicians is likely to continue.

The above extract from an article in the "Bulletin of the American Medical Association" for January, 1924, orchestrates the drift of a great contemporary movement. Medical science of the last generation consummated its great successes by studying patiently the personal peculiarities of germs, their ways of living and methods of attack. The triumphs of the medical sciences of the last forty years—triumphs of achievement of pure knowledge and applied knowledge, of most brilliantly successful modes of approach to the causes and healing and prevention of disease—have been the triumphs of the same methods that provided the amazing accomplishments of physics and chemistry in the last forty years. But in the last ten years a great movement for the study of the personal peculiarities of people, sick or well, from various angles, has been inaugurated with equally amazing results.

The accepted modes of inquiry into what is called the history of one who is ill and the more or less systematic ascertainment of the condition of his organs, which goes by the name of the physical examination, were developed by men confronted with a very urgently immediate task, the relief of disease. Most concerned they were with getting information concerning the state of or-

gans post-mortem experience had informed them might be responsible for the presenting symptoms. Naturally, they came to be most preoccupied with the gross situations obtaining in the machinery usually spoken of as inside the body—the heart and the lungs, the liver and spleen, the small intestines and the large intestines, the stomach and the kidneys. Like the workers in all the other sciences, they were limited to the exploitation of the material offered them by the so-called five senses. And they accomplished wonders with them, once the unhampered study of anatomy had furnished correct ideas regarding the locality and boundaries of the various organs, and the changes of disease.

Then came the achievements of the great Laennec, who invented the stethoscope. From the very beginnings of modern medicine instruments used in physics and chemistry have been directly taken over or adapted to produce records of precision, extending the range of the senses as well as acting as a check upon them. X-ray plates are the examples par excellence of a magnification of the power of hand and eye to map out alterations in the size, shape, and consistency of viscera. Of late, moreover, functional tests have been elaborated to supplement the other procedures. Thus

the efficiency of the organs of circulation and respiration of various parts of the alimentary and nervous system, may be tested more or less satisfactorily.

One who deals with and heals the sick must necessarily be preoccupied with the natural history of disease. The fevers and poisonings, inflammations and deformations, it has been found by the recurrent presentations of experience, each have a certain history, a variably characteristic biography. Each tends to begin in a certain way, to evolve various typical phenomena, to run a more or less regular course to end in a more or less uniform way. So to a disease with a particular life-history has been given the name "typhoid fever," to another with another life-history the name "cancer." Text-books on medicine contain the careful compilations of gathered data which enable one to separate and to label sickness and so predict its nature and outcome.

There remain, however, these interesting questions: Why has this particular lesion attacked this particular individual? Or, why is this specific individual suffering from this specific disease? Is there nothing more in the clinic than merely diseased spots in individuals?

There is the individual himself. Long ago

William James emphasized that the abnormal always throws light on the normal because it is an exaggeration of the normal. That is, normal tendencies and normal forces, normal directions, when intensified and prolonged, produce the abnormal. Careful study and analysis of the abnormal may, therefore, be made to yield the secrets of the mysteries perambulating as the normal.

Converging lines of attack closing in upon the problem indicate that three sets of materials or substances contribute to the creation and sustenance of individuality. These are the chromosome materials in the fertilized cell as which the individual commences his being, the nerve materials which keep him in touch with the outside world, and the glandular materials, the products of the glands of internal secretion, which are the regulators of his chemistry. The bulk of the evidence demonstrates that the changes in constitution and personality in the embryo, the child, the adolescent, and the adult, producible by changes in the glands of internal secretion, far outnumber changes elicitable by other agencies. The writer has concerned himself with these changes for the last ten years, convinced of the fundamental importance of the chemical in the series of events

in the cells of the individual which truly constitute his life-history. No one denies the possible and actual influences of other agencies. It will be found, however, that when the changes, provoked by these other agencies, cannot be traced to their effects upon one or another of the glands of internal secretion, they form a class distinctly in the minority. As the key-points of his chemical machinery, they are the mediators not only between the individual and his heredity, but also between the individual and his environment. No one therefore can exaggerate their significance.

Much, a great deal, about them is unknown and remains to be discovered. Much is only suspected or guessed. Much is erroneously conceived as the truth or put forward as the truth by those insufficiently or narrowly trained in the methods of science or interested only in the commercial exploitation of their possibilities. But much is known and has been correlated into general principles and a system of information which should form part of the general mental equipment. In all of the sciences finality of statement is always relative—relative to new facts and conceptions that may be obtained by the restless urge of curiosity and discovery. New solutions always create new problems, alinements, and attitudes. Never-

theless let us be thankful for what we have. Sufficient unto the day is the knowledge thereof.

LOUIS BERMAN.

New York.

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CHAPTER I

A PERSON UNKNOWN

A STRANGER, introduced as Mr. Apparently Normal, Mrs. Obviously Abnormal, or Miss Queer Fish, is brought for examination before us, an imagined group of men and women who have taken seriously the dictum that the proper study of man is man. Among us are interests as varied as those of traveling salesmen exchanging anecdotes over their cigars in the smoking compartment of a Pullman, or ladies of leisure gossiping over their tea in a Fifth Avenue shop. There are bored business men, tired of the infinite amount of buncombe preached and published concerning character and personality and success. There are similarly minded novelists, employment managers, teachers, psychologists, actors and actresses, physicians and surgeons. And last, but not least, there are the ordinary but still intensely curious Bill Joneses and Tom Smiths who, aware

of their ignorance and confusion about the nature of their fellow-creatures, have become acutely conscious of the value of a systematic survey of the scientific methods used and results obtained in the modern interpretation of the individual.

As our subject stands before us, stark and rigid, he presents the familiar spectacle of that remarkably shaped forked animal, *Homo sapiens*. There is the more or less globular mass with sculptured front, known as the head. That narrows suddenly or gradually into the cross-section of a column, the neck. Which, in turn, expands into the great volume of the trunk or tool-box, as Samuel Butler called it, with its attachments, the upper and lower branching extremities. We take in with a glance an average, every-day individual as he presents himself to inspection, viewing him as a whole and disregarding details.

But that momentary view is gross, crude, and superficial, it goes without saying, and donates merely a fraction of all there is to be observed, inferred, or known concerning Mr. X. A complete stream of impressions exudes from his surface that appeal to the judgment, the instincts, and the intuition of an observer. All sorts of details of feature and carriage, skin texture and muscle

outline, blood and flesh make themselves felt.

Moreover, the ensemble is more than a collection. The whole is a fusion of parts that are a unity, a harmony of composition, many in one and one out of many. These, working together in spite of their multiplicity, convey the sense of the existence of an essence, "that subtle something" —an individuality.

"That subtle something" is a phrase used in several languages to cover an indefinable reality, or rather a reality that cannot be put into words. Yet the underlying assumption behind even its vague implications is that the personality is a concrete oneness, a pure substance, in short a simple thing. There is another phrase that suggests the existence of an unanalyzable block of stuff as the quintessence of individuality—"the ego."

Five minutes of consecutive thinking will convince the most thoughtless that "that subtle something" is the most complicated complexity in the universe. Besides its mysteries, the chemical composition of a star of which the light reaches us after three hundred years becomes as easy and simple as a Chinese puzzle. And not only is it the most complex; it is the most variable changeling

known. From hour to hour, from day to day, from experience to experience, it changes its hue and flavor recognizably.

Yet the personality is an entity, because for practical, every-day purposes it can be, it must be dealt with as an entity. But no man can say where his personality begins or began in time and space. Nor where or when one soul is divided from another. When the hypnotized Trilby sings divinely, as Svengali conducts, whose is the will, the emotion, the intellect? When the navel-cord is cut at birth by the obstetrician's scissors, what has happened to the individuality of the new-born? And if the navel-cord is replaced by apron-strings, what spiritual knife transects the invisible bond between mother and child? If material continuity of its component parts is to be considered the test of the actual boundaries of a person, then the you of to-day is identical with the minute bit of protoplasm, less than one hundredth of an inch in diameter, with which you commenced as a fertilized ovum, or what might perhaps be described, with equal accuracy, as the fertilized spermatozöon.

To the man who studies embryos in the different stages of their development, the baby at birth is simply the effect of a series of transformations

undergone by a minute particle of a peculiar jelly endowed with life and capacity for infinite self-reproduction. Beginning as a tiny droplet invisible to the naked eye, it swells and grows and divides. It becomes something that looks like an acorn. Then there are infoldings and buddings of parts, a complication of designs and patterns until there is produced a creature that reminds one very much of a fish, with structures like gills in the neck. This quasi-fish is replaced in turn by forms which eventually evolve into the semblance of the embryonic forerunners of certain apes. Finally, by a series of additions and subtractions, the ape form becomes the recognizably human form. The normal infant, once ushered into the world in spite of its cry of horror, possesses the characteristic stigmata of its species.

Now, at what point in this pictorial film of the changing body of the individual developing in the womb, changes so amazing as to throw completely into the shade any achievement of conjurer or chameleon, does the entity we have been talking about, the personality, appear or enter? It cannot be said simply that the baby is born with a zero quantity of the stuff, so to speak, and that its post-natal experiences are transmuted into an equivalent which as a whole passes for its soul.

Even the inexperienced mother will assert emphatically that her new-born has an expressive individuality of its own, an opinion in which she will be confirmed by every experienced obstetrician and nurse. Besides, it exhibits at once signs of instincts, needs, and demands which prove the existence of a definite though germinating psyche. At what point, therefore, before birth, shall we say the personality commences?

The body and the personality are the simultaneous manifestations of that terrific unloosening of forces and materials that occurs when sperm meets ovum.

Once it is admitted that there is a spiritual as well as a material continuity between the impregnated ovum and the mature individual which it becomes, the way is opened for questioning the line of cleavage which is ordinarily drawn between the personality of the child and the personality of its parent. May not that line of cleavage be purely an imaginary one, created for the convenience of measurement and practical purposes, like the imaginary lines about the earth drawn by the geographer, which he calls the equator, and the lines of latitude and longitude?

Let us, therefore, admit at once, as a fact enormously complicating our problem to understand a

given person by analysis, that it is impossible for us to state with the mathematical accuracy seemingly desirable the precise point in time and space at which he commenced to be. That is, every Tom, Dick, and Harry, through his parents and ancestors, is really the prolongation in a certain direction of personalities that together constitute a great single personality which is one in time, if not in space, and which may be named either Life or God. Tom, Dick, and Harry are really cross-sections of the Great Life and Personality, connected with it by bonds invisible and intangible. Granting that, our analysis of our subject cannot, like all good biographies and novels, begin at the beginning of the story, but must, like all good dramas, begin at the middle or thereabouts.

What, then, is a person? Though biology teaches that he is a product of a long line of evolution of a series of bodies, each linked by a definite physical bond with its predecessor, in himself he possesses an organic unity, a seeming completeness and harmony of parts, in short an individuality, which stamps upon him those qualities that make him what he is—essentially what we mean when we speak of him as a person or personality.

Yet it must have occurred to all novel-readers

and play-goers, as well as professional and amateur students of mankind to ask, just what is the difference between them? The asperity with which the traditional maid announces or used to announce in the conventional drawing-room drama or novel the presence of a "person" and the deference with which she reported a "gentleman" or "lady" would lead a Martian to believe that she was distinguishing one lower despised variety of the human race from another variety, higher and, therefore, welcomed. According to the dictionaries, and also in legal documents and phraseology, the word "person" is applied in common speech to a mass of matter having the shape and looks and actions of a human being. A very broad all-embracing and tolerant definition, including all of the so-called human race, the phrase which was the comment upon his fellow creatures of a famous Chicago wit. But that is what the housemaid really means when she reports so contemptuously the waiting of a "person." She intends to emphasize that she is speaking simply as a zoölogist; that there is one without who is a unit of the species, possessing the external characteristics in the abstract, but without any additional importance or significance.

To an observer without prejudice, however—

and particularly without scientific prejudice—the person is a *unit* of the species only in the abstract. Regarded artistically, logically, or philosophically, he or she is a striking, unique, outstanding individuality. Were we not hurried by the urgent pressures of the immediate, or beguiled by the safe familiarities of the easily classifiable and pigeonhole-able, we should stop in amazement and marvel at the infinite variation in every person we meet, even at the man who interrupts us for a match or the time.

To be sure, he is a sample of a species. And as such he is subject to classification and labels. In the language of dealers in dry goods, we may spot him at once, almost instinctively: that is, without applying any conscious criteria, as belonging to the firsts, the seconds, or the odd lots. But for all that, no matter how little may be his value to himself, to the group in the society to which he belongs, or to the species as a whole, to the true biologist he is a rare wonder, a curious phenomenon, an unending puzzle. An indivisible whole, yet with roots stretching back to the beginnings of all life—with potentialities extending toward the infinite, and yet self-determined and self-regulated, pulsating and behaving as a unity. And unique and complete in himself as he may be,

there are wrapped up in him, too, all the possibilities of interaction with the other unique beings about him.

To the deepest insight, the individual is a complex of *potentialities,* inherited and acquired. Some of them become realized, expressed, crystallized. Others remained forever inhibited or stillborn. Or he may hand on unrealized potentialities to descendants, who under the right conditions will actualize them in form or function. Originally he is just an ordered arrangement of possibilities, transmitted by his progenitors, peculiar, as we say, to his line as well as to his species. And in each generation the arrangement is like a cross-word puzzle or an anagram composed by a master, using the same elements over and over again, and attaining a new creation. Again the lime-light concentrates upon the novelty of the individual, pounds into our stubbornly forgetful classifying consciousness that he is a never-before-happened, never-again-to-happen phase in that magnificently variant continuum we call Life.

To repeat, if we are to study a person, it is difficult, most difficult, to limit and define that person in time and space, easy enough though it may seem. No one who has followed the discussion

thus far can afford to let that thought escape him one moment. It is a thought that has the most important consequences, both practical and theoretical, in our quest. All the evidence points to one conclusion, that the line of cleavage between parent and child, which seems so great, is strictly comparable to the line which separates one stage in the development of the parent from another—say the youth stage from the old age stage; or one stage in the development of the child from another—say the mewling infant stage from the baseball-playing boy stage. Every one admits that there is a vast difference between the personality of the Tom Jones at the age of six, say, and Tom Jones at the age of sixty. Yet we may speak of them as one personality, one in time and space. To argue that we do so because of the existence of a material continuity between the six-year-old and the sixty-year-old is fallacious, because there is probably not a single cell in the sixty-year-old of the body of the six-year-old. The processes of metabolism see to it that there is a continuous replacement of the stuff of cells by others. The body of the six-year-old is certainly not the body of the sixty-year-old Tom Jones; the latter is the six-year-old Tom Jones transformed, that is to say, changed, modified, made over by

time, but still responsive to the prime law of logic, the law of identity, which states that *A* is *A*.

So likewise, though the existence of a material break in continuity between parent and child is more obvious than the break in continuity between parent at one stage and parent at another stage, and child at one stage and child at another stage, the difference in obviousness is one of degree only. The child may be regarded as a bit of the parent, indeed, the concentrated essence of the parent (at the moment of breaking off from it which we name reproduction), that has gone on to become transformed.

In reproduction, when there are two parents, there are two personalities that meet. And the clash of these personalities is the most vital and influential of the forces that determine the make-up of the individual. So when ovum meets sperm, or sperm meets ovum, the meeting may be regarded as the first of the revolutionary adventures and experiences each is destined to undergo as it changes and evolves. And as happens in all conflict, there results among the forces subjugation, or compromise. In heredity, these things are spoken of as dominance, recession, or blending. Behind the veils of these processes in the apparently new personality of the offspring, the

personalities of the parents, the personalities of a long series of parents, the ancestors, are waging warfare.

And as memories of experience that have been intense, moving, and vital remain longest and strongest in consciousness, it is interesting to think that perhaps the ancestors who have been most vigorous, most individualized, most alive, will be most powerful in the line of descent. That should be most heartening to certain people, particularly those who contend for a governing class of notables and those descended from notables.

At any rate the personality of the child and the personality of the parents may be soberly looked upon as literally parts of a more inclusive and, therefore, greater personality. That conception in turn provides a basis for the idea of a family or lineal personality and a rationale for family pride. Both these biologic speculations, of a possibly legitimate governing class and a conceivable family personality, must naturally be extremely galling to contemporary democrats, socialists, and equalitarians of every sort. By putting up lamentably inferior specimens of governing classes and family personality, as well as by adroit manipulation of the statistical admissions that all our ancestors become hopelessly jumbled as soon

as we go back a thousand years, the case for aristocracy may be thoroughly riddled, and yet not completely relegated to limbo. By and large they remain true.

The unity of the personality of parents and offspring remains inescapable. Though for practical purposes we must distinguish between them, the truth is that in neglecting and ignoring their oneness we are leaving out part of the truth. We are, therefore, not taking into consideration the whole truth, and we consequently cannot pretend to deal with the truth and nothing but the truth. If our motto is to be "Truth above everything," we must set it even above the convenience of the manifestly elementary. In this task we have set ourselves of understanding a person by studying his personality, let us remember always the trickeries of the intellect.

As a matter of fact the word "person" should deceive no one. It was never meant to deceive; rather to warn. Like a number of other trick words of the language that derive from the Latin and Greek, it once meant something quite other than that of which it is now the symbol. It was the name for the mask which covered the face and head of the actor who played in the self-conscious tragedies and comedies the ancients lis-

tened to in their amphitheaters. The meaning of the word was transferred, by a natural association, from the mask to the actor's rôle in the drama, and then from the part to the player himself. So the list of characters was headed "Personæ Dramatis." Then, as if all the world took seriously Shakspere's conviction that all the world 's a stage and all the men and women merely players upon that stage, the word became the label for single specimens of that remarkable species which has presumed to call itself, a bit prematurely to be sure, "*Homo sapiens*" or "the wise"!

In our subject standing before us, then, we must recognize above all things that we have no isolation, no finality, no fixity. Though for the purpose of our study we must consider him apart and snap-shot his personality as if it could be suddenly pickled in formalin. Simply a stage in a process of becoming, an act in a very long serial play, a scene in a novel of many volumes.

The classifying and analyzing passions of the intellect—like all passions self-satisfying in spite of all concomitant and consequent incongruities and grotesqueries—will be bound to ignore these principles. Let us resolve, therefore, always to remember, no matter to what our research may lead, and no matter what fascinating details of

mechanics and underlying laws it may reveal, not to be bewitched by the narcotic effect of familiar recognition and placing which any class word produces. When we say we have before us a person, we should envisage him always as a developing sprout out of and along the invisible stem-root, Life, and at the same time a unique variant. In bond material and spiritual to the chemistry, experiences, and history of his forebears, and yet separate, detached, and unlike them all, to work out his own salvation.

A unique variant begotten of a unique variant. Likeness and unlikeness, sameness and difference, resemblance and variation, of parent and offspring, have fascinated and disturbed the minds of students from the beginnings of the history of the human intellect. Do we to-day possess any light on the paradox? Calling into consultation the accredited modern students of heredity (with which word we may be inclined to dismiss the subject), what information have they for our disposal in solving the mystery of Mr. X?

Nowadays the protagonists of heredity are going strong. By the application of empirical data and the trial-and-error method, breeders and farmers and horticulturists and fanciers of every sort have selected and improved the individual

qualities of animals and plants upon the hypothesis that their essential characteristics were handed on from parent to offspring, and could be depended upon to breed true, by direct mating. Indeed, the achievements of specialists in the domestication of animals and plants were what impressed Charles Darwin so profoundly as to have him make them the basis of his theory of natural selection and evolution.

The government of the United States and various States, basing their efforts upon the law of constancy of individual inherited characters, keep expensive experiment stations at which, besides the experimental matching of desirable traits, records are registered of the pedigrees and productivity of cows and pigs and poultry and all varieties of farm biological interest. Recently the State of Kansas established a similar institution for human beings, the Eugenics Building, in its capital city, Topeka. It is an out-growth of the activities of the Kansas Bureau of Child Research and Fitter Families Association.

Fundamentally, the principle involved postulates that the productivity of any given desirable quality in human beings may be increased by inbreeding, and the ostracism of any undesirable quality by outbreeding. In practice the principle

has been put to the test among human beings in the professional wrestlers of Japan. They form a special class, whose members hand on their secrets as heirlooms from generation to generation, and marry only among themselves. As the process of selective breeding has thus been consciously carried on for several centuries, there has been evolved an individual so physically superior that a man or woman of the professional wrestler class stands head and shoulders above the other Japanese when seen in a crowd.

Statistically the students of heredity are endeavoring to show that such personal characteristics as health, intelligence, temperamental quality, and body build are family possessions. In Kansas Governor Henry J. Allen signed a bill to award prizes to the families who should be examined and declared fittest to survive. The State Board of Health has worked out A, B, and C certificates to be awarded to applicants taking the tests at the time of the great annual state fair. A family history as complete as possible is first obtained, including the traits and causes of death of relatives, as well as any striking ailments. Searching inquiry may sometimes thus produce information of the greatest value to the student of personality. Then detailed examinations of the

body and mind by physical and mental tests followed. Each examiner scored his own findings. Finally, the individual has a total score, based upon the relation of the several specialists' scores. It is reported that in the first tests seven first-class prizes were given to families whose every member attained high-level scores, awarding them in effect the right to call themselves the first seven families of Kansas. Besides, 145 medals went to men and women scoring high. These high-graded individuals were also advised about whom to marry and whom not to marry, on the basis of our present knowledge as to the hereditary transmissibility of the tendency to diseases, like tuberculosis, epilepsy, insanity, cancer, and so on.

Popular opinion has summed all this up in the phrase, "a chip of the old block." The Kansas experiment is interesting because it shows that a practical method has been worked out for studying a person from the ancestral standpoint. The Ancestral Person, as perhaps for convenience we may call that part of the personality composed of the contributions of ancestors, is subject to analysis. The ancestral influence has always been recognized. Technically, the Ancestral Person is being described as the Genotype. From our standpoint, that of understanding the person himself,

how much do we really know of the how and why and what of the mechanics of heredity?

When Darwin focused the most intense interest upon variation and variants as the most piquant problems of biology, the experimental study of heredity in plants and animals became the center of research of the science. A great number of observations were collected by such indefatigable workers as Bateson. But it was not until 1900 that the experiments and conclusions of Gregor Mendel, a priest, conducted quietly in his garden decades before, and then buried alive in the proceeding of a local society, were suddenly rediscovered and then appraised at their proper value. A great many researches carried out since upon plants and animals have seemed to confirm the validity of Mendel's laws; that the essential characteristics of an individual plant or animal are not the results or products of environment, training, education, or habit-formation, but are the expression of the influence of specific determining factors, each a unit in itself, contained in the ovum and sperm and transmitted and distributed according to simple arithmetical rules.

Just as an atom is an arrangement of electrons, a molecule an arrangement of atoms, a substance an arrangement of molecules, so an individual—

at his début—may be looked upon as an arrangement of Mendelian units. An arrangement indeed that is dynamic like a symphony, and not static like a painting; but the notes that play out the music, concordant or discordant, of his life are all inscribed in the original protoplasm as which he began his being. All potentialities are inherited. The environment can but stimulate their function or inhibit and suppress their expression, but beyond that no more. Each individual quality or capacity may develop in degrees that run the gamut from zero to 100 per cent. Circumstances act only as provocatives or irritants, directors and molders, narcotics or destroyers, of the primary tendencies. Character and behavior, soul and conduct are inborn; the milieu can modify them for good or evil up to a certain point, but can never make them.

All this is simply saying that protoplasm is not wax but that protoplasm is protoplasm, subtly responsive to stimuli, but with a tremendous inertia of its own. It is when we behold the prospects and achievements of control in heredity that the consequences of the doctrine can be appreciated.

Gregor Mendel worked with peas and other plants. From the experimental viewpoint, the technique is tedious. One needs a garden; one

must wait seasons for the study of a relatively few generations; one must beware of dozens of annoyances. The zoölogist, looking about for a more convenient reagent, hit upon a tiny animal which satisfied a number of requirements. It will breed easily in bottles, which may be kept upon library shelves; it is so tiny as to be easily handled in hundreds; and it breeds very rapidly. It is the smallest of flies, the fruit-fly, *Drosophila melanogaster,* which may be seen wildly uproarious in the neighborhood of rotting fruit.

Morgan is mainly responsible for this exploitation in the interests of science of a single species of the fly, recently stigmatized enemy of mankind. Through its study, it has become possible literally to put one's finger on the definite chemical mass which goes with and hands on a definite trait or characteristic. This mass is known as a gene. Thus the normal, that is the usually occurring fruit-fly, is gray in color and has red eyes. Careful study of a large number of breeding fruit-flies showed that there were always cropping up variants; that is, individuals different from the routineering repeaters who constitute the norm of the species.

First a variant with white eyes was detected. Others were found whose eyes were colored yel-

low, vermilion, purple, and so on. Then the color of the body might differ in appearing yellow or brown or black. Other characteristics too would suddenly change definitely, such as the shape of the wings or the distribution of hairs.

Individuals deviating so strikingly were selected and permitted to breed freely. It was found that they would breed true, transmitting their peculiarity for generations. A single individual would then produce a whole race characterized by the modification of which he was originally the lone possessor. Such individuals are known as mutants, and the process as mutation.

When one mutant is crossed with another mutant, or with the normal, they will breed variants who will be fertile, and who will exhibit characters that are a blend of the matings. A normal gray fly matched with a black mutant will generate offspring that are obviously somewhere midway in their coloring. But the character of the mutant does not wipe out the peculiarity of the mutant. Each obeys the law of Mendel that in reproduction the characteristics of the parents are preserved separately in the germ-cells, as in any functioning mixture, and behave independently, though they may compromise, neutralize, or reinforce one another in the body which the germ-cells' union

evolves. Variants, therefore, are the result either of mutation or hybridization. The transmitters of the qualities in the germ-cells are the genes.

As a consequence of the small size of the fruit-fly, which makes possible quick microscopic scrutiny of its genes in thousands of individuals in a relatively short time, it is feasible to follow the fate and action of different genes. In turn, the result of different breedings have been predicted satisfactorily. New races indeed have been made according to specifications. The adventures of the genes, that is heredity. And heredity controls the inherent elementary make-up of the individual.

Now, however, it was noted that environment or external influences may determine the amount of development of a particular characteristic. When fruit-flies are grown in food that is insufficient or inadequate, they will be stunted. But even after several generations of such stunting, return to adequate food will mean return to the normal size of the breed. It is legitimate, then, to speak of a third, temporary, or environmental type of variant, due to suitable or unsuitable environment.

But observe, this admission of a possible influence of environment is an admission fatal to the

doctrine of absolute predestination as preached by the protagonists of simple Mendelism. It has become fashionable lately among certain popularizers of biology to proclaim early and late that "science" (though they really mean only that portion of biology cleared by Mendel and students of heredity who have used Mendel's rules in their studies) has now settled forever that a man's nature and character are fixed for him before birth by the inexorable "laws of heredity." The most fanatic of the disciples of Calvin who swallowed whole terrific assertions about predestination, damnation, and salvation could not hold a candle to the fervor of the new prophets of the Mendelian elect and the Mendelian damned. How much assent, how much acquiescence are we to give to the view (boomed loudly, however, not as a view but as a proved gospel) that if we only knew enough, every man could be stated to consist of an arrangement of genes, expressible mathematically as a Mendelian formula, which would contain everything that he was or ever would be? How much respect are we to pay in consequence to the theory that our Mr. X is a product of his hereditary constitution which is truly the complex we are to untangle if we are to understand him.

As a matter of fact, the mere asking of these

questions, let alone the answering of them, has been achieved by ignoring fundamental principles, fundamental facts, fundamental conceptions of science. Nothing in the history of science is more strikingly instructive concerning the foibles of mankind than the regularity with which causes have been furiously advocated and defended or smashingly attacked and ridiculed in complete contempt of the data of the sciences of physics, chemistry, and logic. The results contrast amusingly the flights of the enthusiasts with the reactions of their critics.

The actual position of the modern students of heredity is far different from what the popularizers of biology would have the public believe. We have a student of the subject like Professor H. S. Jennings saying, "*Possibly we should be better off with no such conception as heredity:* then analysis would be correctly directed toward understanding in organisms as in other things, in what ways there is dependence on the stuff they are made of: in what ways on the conditions in which that stuff is found." There you have stated shortly the gist of the matter.

To a chemist it is obvious that we shall not be in possession of a true science of heredity, that is the science of how his parents affect and influence

the individual, until we have a chemistry of heredity. Lacking the details of such a chemistry as we inevitably must—as regards the chemistry of all living things our knowledge is to our ignorance in about the relation of a glass of water to the ocean—we should at least apply or try to apply the general tools of thinking already ours.

It is accepted in chemistry that the behavior or properties of a substance, pure or mixed with other substances, depend in part upon itself (that is, its chemical constitution) and in part upon the circumstances in which it is placed. This may indeed be regarded the ultimate generalization of the great branch of chemistry which deals with these matters, the science of physical chemistry. If in the genes of the students of heredity there are substances acting like pure chemicals, or chemical mixtures acting like a pure chemical compound, it is manifest that they are not confined in a glass case or in a vacuum. They are avowedly placed side by side. They must influence one another. They must be influenced by what is outside them, which is environment. Their influence is conditioned and conditional.

We must conceive the interaction of the genes as a series of linked chemical reactions; in fact, as an interdependent series of chemical reactions.

From the moment of fertilization of egg-cell by sperm-cell Jacques Loeb showed there is a chemical reaction, an oxidation, which in turn begets another chemical reaction. Of this second chemical reaction a substance or substances must be the product, which in turn begets more chemical reactions. We have to deal in the fertilized egg with all its genes, it cannot be repeated too often, with a mixture of chemicals, capable of a diversity of chemical reactions. And all chemical reactions are dependent upon conditions. True, the chemical reactions of development maintain a certain goal or model. But alternatives of arrangement are conceivable and have been observed to occur with change of conditions; that is, environment. With that realization collapses the simple predestination gospel of naïve Mendelism.

To quote Professor Jennings again: "But this theory of representative particles is gone, clean gone. Advance in the knowledge of genetics has demonstrated its falsity. Its prevalence was an illustration of the adage that a little knowledge is a dangerous thing. The doctrine is dead—though as yet, like the decapitated turtle, it is not sensible of it. It is not true that particular characteristics are in any sense represented or condensed or contained in particular unit genes. Neither eye,

color, nor tallness, nor feeblemindedness, nor any other characteristic, is a unit character in any such sense. There is indeed no such thing as a 'unit character' and it would be a step in advance if that expression would disappear."

It is not in order to review in detail the evidence and argument that may be marshaled to demolish the case of the heredity fanatics. A man resembles his parents because he gets from them the original chemical materials, placed definitely in time and space amid varying conditions, which commence to react and to interact, and so immediately to acquire a biography, a history. Innocent new-born babe as he seems when he first sees the light of day, he is chemically an aged being, the product of thousands of interlocked chemical reactions, into each of which there may have entered countless modifying influences.

And, after he has been born, he continues to develop, to grow and to change, through the medium of chemical reactions and conditions like food, heat, or light, and all the variety of agencies that may be spoken of as environment. The adult individual is the outcome of a tremendous number of chemical products, intermediates in the process of development. Among the most important of them are the internal secretions or hormones,

chemicals made by the cell-factories known as glands. Before we go on to consider the contribution of these endocrines to the personality of Mr. X, contributions so great, so dominating, and so controllable as to merit their designation as regulators of personality, it is well to get clear in mind, in order to rid ourselves of the thought that perhaps we are altogether upon the wrong track: (1) it is not necessary to have a characteristic merely because one inherits it; (2) what one inherits is certain material that under certain conditions will produce a particular characteristic. The most influential of these conditions are the chemical. Therewith the bugaboo of heredity as the absolute despot of personality formation is banished.

That, however, should not encourage the ballooning of a new bubble of environment. Nor should it bring a return of all the old fallacies of education. Though an adage to the effect that you cannot make silk out of a sow's ear is absurdly applied in relation to material as complex and plastic as protoplasm, it remains the fact that materials are materials and conditions are conditions. It would perhaps be better if the words "environment" and "heredity" were thrown into the waste-basket altogether. It would then be possi-

ble to concentrate upon the understanding of the unique individual before us and analyze him from the three following standpoints:

(1) The Ancestral Person, that part of him which he owes to his ancestors, physically by way of the genes and the material with which he has begun his separate existence, and psychologically by way of the memories of experiences of his ancestors, stored in the genes and materials.

(2) The Historical Person; that is, the personality as it has been modified by its own experiences and memories, habits and reactions, in short, its own history. The Historical Person may be said to begin where the Ancestral Person leaves off. Or the Historical Person may be said to be a continuation, a prolongation, of the Ancestral Person. All those influences which have been traditionally summed as environment may be entered under the rubric. The conception of the person as striving to accomplish is important in this connection.

(3) The Physicochemical Person; that is, the person regarded from the fundamental viewpoint, since it embraces both the life

of the ancestral person and the historical. It is the person regarded from the standpoint of his chemistry, from the beginning to the end of his life, and particularly in regard to the relations of his chemistry to those manifestations of character, behavior, and conduct which strike the observer as the most salient in his make-up. The soul of the man is a complex problem, the most complex problem in physics and chemistry. The blood and the nervous system and the glands of internal secretion form a triumvirate of chemical machines whose integrated functioning is the soul. There is every reason for believing that life is a piece of chemical clockwork and its manifestations are the result of the sum total of the activities of the chemicals in living matter.

CHAPTER II

ARE WE GLAND-CONTROLLED MARIONETTES?

OF all the definitions of man concocted by clever men, perhaps the most appealing is that he is the animal who loves to torture his mind with problems insoluble because of their premises. Tantalizing questions concerning his own nature and destiny, based upon the unknown and the unknowable, the indefined and the indefinable, he adores. Always, in his countless attempts to understand the multiple difficulties of the universe outside himself, as well as the complex oddities of the microcosm inside himself, he has enjoyed the sadism of the pseudo-problem. His favorite indoor sport has been to play with words and phrases, vague sounds and vaguer symbols, and to sustain the intellect with the feeling of the fine essence of final truth attained.

Juggling with abstractions has been a most alluring mental occupation. Its practice implied defiance of the great law of thermodynamics that it is impossible to get something out of nothing.

How often, for our intellectual dervishes, has the mystic dance of reason consisted in going round and round the infinity of their ignorance, and chanting variations of a theme that may be parodied as: assuming that two and two make five, how can we prove that they make four? No wonder, then, that the ecstasy of the philosopher has so often provoked the headache of the normal.

One of these ache-producing inquiries that has delighted the professional philosophic heart and provided almost inexhaustible material for its acrobatic gymnastics has been the problem of free will and responsibility.

Are we, lone wandering mortals upon a satellite of a lesser star, free agents? And in what sense are we free agents? When you put the question to that healthy but naïve convenience, the Normal Mind, you elicit a stare.

When I start out to take a leisurely stroll in the daylight-saving hour, am I not free to turn to the left instead of to the right when I come to a cross-road? May I not stop to linger over flowers by the wayside when I so will? May I not decide to sit down on a bench and submit to reverie if I so desire? May I not, within limits, and at my peril or pleasure, pick and choose my way? Or do you dare to assert that every step and move is

determined and predetermined? Is each the inevitable and irreplaceable link of a mechanical chain of cause and effect, each the click of a machine in an orderly array of clicks, my consciousness of freedom being but an illusion that is connected in some way with an absence of perception of certain parts of the clicking mechanism? Do you seriously intend to suggest that my sense of myself as a choosing self and deciding will, at times so acute an awareness that it seems to be burning and consuming the whole being, is like the image in a mirror, which looks upon that which has created it but which can influence it not at all?

To the philosopher who admits the validity of the ordinary instruments of thought, your questions are not intimidating. Unblushingly unconscious of branding himself with the contempt of the legal mind for him who disclaims patent responsibility for his acts, or the opprobrium of that now so popular epithet of abuse, the inferiority complex, he solemnly denies your powers of choice. The lawyer and judge protest with all their tremendous capacity in that direction, including the manipulation of every sort of technicality. Do you know what you are doing? Did you know what you were doing? These are their favorite queries in establishing responsibility.

Says the philosopher calmly: The Law of Cause and Effect applies, must apply everywhere, without exception or cessation. If not, it breaks down immediately and completely as the most fundamental law of thinking. Besides, since we are asking questions, let us continue to ask questions. Who of us knows what we are doing? Who of us has ever known what he did? Is not our knowledge of nerve and muscle, blood chemistry, stimulus-response-reaction, altogether too meager, too fragmentary for any of us to presume to assert that he has a knowledge of the mechanism of a single apparently simple act? Or dismissing that as sophism, does not even merely common-sense analysis of so much of our conduct reveal hidden motivation, decisions and choices that have been caused, or at any rate modified, by experiences in the past or factors in the present utterly beyond our control? As the protagonists of free will, it must be admitted that if we are free to any extent at all, we are, we can be free only to a certain extent.

How much are we, can we be free? How much are we, can we be controlled?

I shall not attempt in this discussion to review the metaphysics of the notions of cause and effect, or freedom and determinism. To all those who

are interested in the most recent of professional pronouncements I commend, if they have a taste for that sort of thing, the chapter "On the Notion of Cause" in Bertrand Russell's book "Mysticism and Logic." The heaviest contemporary artillery directed at the problem may be found in Broad's "Scientific Thought," in which are placed the ideas of cause and effect in the space-time system of Einstein. I propose to stick to the everyday definitions of the Man Who Reads Newspapers, who views that which he can control as subject to his will, and so names acts associated "free-willed," while he regards that which is beyond his control as caused or determined, and acts associated as necessary or compelled.

Perhaps we may dodge the issue, if we are Sufficiently Artful Dodgers. The physiology of knowledge teaches that what we regard as the known consists of a modification of the real by passage or filtration through three kinds of mental machinery. Obviously the end-product must be different from the original. That which comes out of the machine must be different from that which goes into it. Obviously all we can do is set ourselves the ideal of science: accuracy in obtaining the end-product. By getting rid of the hallucinations and illusions produced by the defects

of the machinery, truth emerges as uncontaminated by error as possible.

First there are the sensory organs, the mediums of sensations, the eyes, ears, nose, skin, tongue, and similar organs in the muscles, bones, and viscera which are the direct transformers of the without into stuff for the within. This is best appreciated as regards color. Colors are essentially the consciousness of vibrations in the ether of different wave-lengths, after passage through the eyes. Then there are the intellectual organs of the brain, which place their particular impress upon the sensations, and create order out of disorder, the real out of chaos. Kant's great contribution to philosophy insisted upon the function of the mental machinery of knowledge, of the organs of space and time, cause and effect, consciousness and self-consciousness. All knowledge comes to us clothed in these garments compulsory for admission into the inner chambers of thought. Acting always with the sensory and intellectual machinery are the emotional organs which stamp the sensations arranged by the intellect as pleasant or unpleasant in accordance with ancient associations. May not the conflict between free will and cause-and-effect be simply limitations, defects of our intellectual ma-

chinery, and our refusal to accept such a solution a defect of our emotional machinery?

The human mind revolts, for a very good reason, against this pussy-footing conclusion. We are very keenly aware of when we control, very acutely resistant and only reluctantly submissive when we are controlled. Forever the lust of power, the appetite to control more, the hunger to be controlled less, must be regarded a fundamental craving of protoplasm. If we are controlled, if we are determined, cries out that which is deepest in us, let *us* determine what are the controlling forces, how they may be controlled, and then control them for our ends.

We act through the nervous system; that is known. It has been found necessary, though, to distinguish a voluntary part of the nervous system from an involuntary.

The idea that the body is a machine dates to Aristotle and before. But the machine is regulated and adjusted not by the will but by the involuntary nervous system. The heart pumps the blood according to mechanical principles. But it responds to the necessities of extra effort, or diminished effort, under the whip of messages from the involuntary nervous system. The lungs are a bellows. But they are more than a bellows,

because they will be fanned or cooled to greater or lesser action by telegrams from the involuntary nervous system. All the viscera, indeed, may be modified in their functioning by that same will-less nervous system, will-less because not dominated or dominable, not permeated or permeable, by the will.

It may be put this way: The involuntary nervous system is the nervous system of the viscera, the organs of the internal machinery. The voluntary nervous system is the nervous system of those parts of the external machinery which are under the rule of the will; the muscles, par excellence.

If a man's personality is simply a function of the nervous system and if it could be identified with the will, then the voluntary nervous system might be regarded as the organ of personality, and personality as a function or an effect, a product, of the voluntary nervous system. As a matter of fact, no such clear-cut distinction is possible. The personality embraces the will, but is something more than the will, and must be analyzed and understood if we are to understand and recognize the will.

Nor can it be said that personality is simply a function of the nervous system as a whole, volun-

tary and involuntary. An individual may have a perfectly functioning nervous system, voluntary and involuntary, and because of either disease, habit, inheritance, or other defect may possess a poorly functioning muscular system which may stamp his personality as weak, helpless, and ineffective. An anemia, a malfunctioning of the stomach or liver will color the personality blue or gray. Each and every part of the body, in itself, as well as in its influence on the nervous system, must be taken into consideration, because it is sensitive to chemical changes in the blood. The nervous system is the great register of the personality. But the blood and those regulators of the composition and chemistry of the blood, the glands of internal secretion, are the fundamentals in the personality.

The will functions through the voluntary nervous system. How do we know this? Because of what happens to the will when there is an inborn lack or defect, an injury, destruction, or disease of parts of the voluntary nervous or muscle system, with temporary or permanent loss of parts of it. There are definite parts of the brain, known nerves issuing from or connected with these parts of the brain and muscles to which they go, that form in themselves a complete system. This is the volun-

tary nervous system or the nervous system of the will. There are definite spots in the gray matter of the brain which, when stimulated by an electric current, cause definite muscles to move. For example, there is one spot which will react with movements of the muscles of the right leg. It may be assumed that when we "will" to move the right hand or the left leg, these particular spots are functioning. If there should be clotting of the blood in the artery which supplies the spots in question, or tearing of the artery itself by high blood-pressure (popularly known as apoplexy), so that the spot cannot function, the will is impotent, completely or partially, as regards the hand or leg. There is paralysis. Infantile paralysis may achieve the same effect. Various methods have been used for tracing the communications. It is accepted that there is a definite system of nerve-cells, nerves, and muscle-cell connections, intricate in the extreme but in health functioning with a marvelous speed and precision, which is the organ of will.

More accurately, however, the voluntary nervous system, as a mechanism, should rather be called only the chassis of the willing personality. For those nerve-cells and nerve-fibers, integrated to form a system functioning as a whole, are not

isolated like a radio set in a show-window. They are quiveringly alive and sensitive, related with and played upon continually by outside influences. Above them and under them and around them are built other systems of nerve-cells and fibers, which have connections with various other parts of the brain, parts in which are stored memories of things seen, things heard, things felt, and so on.

These association systems, as they are known, bring to bear upon the will past experiences. These association systems might be termed the flash-back systems, for they work in a manner comparable to that frequently employed device of the cinema picture.

Every time we have an experience of some sort, the flash-back system works. Suppose you look up and behold what you recognize as a tree bearing fruit which excites appetite. What has happened in the nervous system? A disturbance has been propagated from the tree to the retina of the eyes. There various chemical changes have occurred, including changes in the visual purple, which in turn were passed on to nerve-cells in the retina, specialists in the transmission of such changes, by their filaments, to the gray matter, where visual impressions are registered. Thus the form and color of the tree and its fruit, per-

ceived, as we say, swiftly revive impressions of trees as experiences in the past, and so are quickly recognized, identified, named. Now the process of change excites other association fibers. Connections are made with memory areas of past pleasurable experiences recorded in the consumption of the fruit. The smell and taste, as well as the feel to the hand and skin, are perhaps revived. Something switches in a connection with another portion of the nervous system always involved in memories, pleasant or unpleasant. That is the sympathetic or involuntary nervous system. Fibers, leading to the salivary glands in the mouth, conduct the movement, the mouth waters, and appetite is born.

What happens next? A wave of chemical change, which has begun with a chemical reaction in the retina, has set up a series of chemical changes. Which have, in less time than it takes to tell, resulted in the production of a chemical mixture, the saliva in the mouth. At this point there is a state, condition, or nuance of consciousness, called desire or appetite. Desire or appetite consists of a will toward the object exciting it. When we say "to will" we mean simply an exaggeration of the movements initiated by that appetite and desire.

There can be no doubt, then, that the chemistry of the brain and nervous system contains the secrets of the will. What do we know about the chemistry of the brain and the nervous system, the cells which are the governing class of the body, the administrators and officials?

If we are to understand *how consciousness becomes energy,* which is the crux of the problem of will, for *willing may be best defined as consciousness becoming energy,* it is worth our while to scrutinize every chemical fact about them we can lay our hands on.

The nerve-cells, the neurones, are the aristocrats of the society of cells which constitute the body politic. They are the aristocrats, because they are more alive than the other cells, more sensitive to change, and more dominant because able to remember and so learn from experience. Among vertebrates, development of the nervous system has been the index of getting on in the world. Increase in the number of nerve-cells, that is gross increase in the amount of gray matter, has been the definite accompaniment of the production of higher and higher forms in the vertebrate series, culminating in man. Man is to-day the Lord of Creation, because he has relatively the biggest and most complicated brain of all the animal com-

petitors. The great brontosaurus had the capacity to hold several hundred men. But his quantity of nerve-tissue, of gray matter, was too small for him to survive the trials and tribulations of a changing environment.

The ability to remember, and to bring back memories to bear upon conduct, is a distinctive function of the nervous system. Now, in the case of blood, all of its greatest functions have been connected with the presence of definite substances. The oxygen-transporting function, for instance, is mediated by the chemical substance hemoglobin. Is it possible to connect the memory-carrying function of the brain with any definite substance?

Nothing is known of such a substance. But rather brilliant guesses concerning its nature have been made by following the clues of converging lines of evidence. It is possible to think that as a result of an experience a substance is formed and deposited in the nerve-cell. This substance may be conveniently designated the memory-trace. Learning would then appear to be increasing the amount of this memory-trace, and forgetting would be its loss, perhaps by diffusion from the cell.

It is interesting to note, consequently, that there

JOHN KEATS

A thyroid-adrenal centered face

are in the brain substances which have some of the properties of certain oils that act as if they remembered things. For instance, there is linseed-oil, which is used extensively in oil painting because, when exposed to air and light, it changes from a fluid to a solid substance. This is brought about by a reaction of the linseed-oil with the oxygen of the air, and is, therefore, an oxidation. It can be shown that when the oil is exposed to the air nothing happens for about twenty-four hours. Then the oil begins to take up oxygen slowly and then more quickly, as if in the process something was formed which assisted the absorption of oxygen. Or, as it has been put by the biochemist Mathews: "It is as if the oil learned to oxidize better and better. Now it may be shown that the oil remembers. If after 60 hours illumination, when the oil is oxidizing at a fairly rapid rate, the illumination is discontinued and the oil put in the dark, the oxidation goes on at a smaller pace. If after a period of a few hours in the dark, the oil is again exposed to the light, it will be found that the oxidation no longer waits twenty-four hours before beginning. For now stimulation by the light is effective within an hour or more: the oil acts as if it remembered the teaching by a previous illumination, and now oxidizes

at a more rapid rate. However, oil can also forget. If left in the dark twenty-four hours or more, after being taught to oxidize, it has forgotten and now the teaching must be done all over again, as long an illumination being necessary before the oxidation begins."

There is, then, a conceivable chemistry of memory and will. Certainly the conception should assist us to understand how various chemicals, including the products of the glands of internal secretion, influence the nervous system, memory, and will. For it is when we come to consider how specific chemical substances like alcohol, morphine, cocaine, caffeine, hashish, or adrenalin affect the mentality, that the absurdity becomes apparent of various doctrines which regard the soul as a ghost residing in the brain and nervous system and acting through it. Their effect presents the most convincing proof that the manifestations of mind or "soul" are the end results of physical and chemical factors interacting in the nerve-cells.

When alcohol causes a sedate clerk to take an automobile which does not belong to him and drive like a madman through crowded city streets, when disease of the brain cortex causes a man to believe he has made a hundred million dollars overnight

in Wall Street, thereby proving that there is no one as wise, noble, or conquering as himself, when a dose of caffeine produces an increased fluency and loquacity, and a dose of cocaine, a feeling that there are no obstacles that cannot be overcome, and that everything can be dared—what has happened to the ethereal soul? If it is not a physico-chemical compound in itself, how can it be acted upon by the physical and chemical? It is a problem perhaps for metaphysicians. But common sense, which looks upon cause as that which effects, must regard them as demonstrations of the "soul" modified by chemicals.

Take a matter so intimate to the personality as dreams. It has been shown that substances administered under the skin and, therefore, not upsetting digestion, but having a direct effect upon the nervous system, will influence the content and character of dreams. This has been known for a long time as regards morphine and cannabis indica. The best report extant of the effects of opium is that of De Quincey in his "Confessions of an Opium-Eater."

But the most interesting dreams have been produced experimentally by means of hypodermic injections of the internal secretions. My attention was first attracted to the relation between

dreams and the internal secretion by a case report of Finley published in 1921. A patient, a woman who was being treated for low blood-pressure, was given, over alternate periods, an extract of the pituitary gland and an extract of the adrenal gland. Like most people, her dreams were colorless; that is, the colors were black and white or gray. Emotionally, they seemed to mean nothing. But after taking the pituitary extract for ten days there was a distinct change in her dreams. They became brightly colored. The patient found herself doing what she had always wished to do, traveling frequently from one place to another. From newly painted cars, patrolled by trainmen dressed in gold braid uniforms, she alighted at pleasantly colored stations and experienced the pleasure of highly pigmented landscapes. Colored dreams were an entirely novel experience, and she was delighted with them. When, however, the extract of the adrenal glands was substituted for the extract of the pituitary glands, there was a sharp change in the nature of the dreams. They became colorless and terrifying, dominated by distressing quarrels and conflicts. Adrenalin, the extract of the adrenal gland, has been shown to increase in the blood in conditions of pain, fear, and anger. An injection of a suf-

ficient dose of adrenalin in a person, previously undisturbed, may cause the appearance of a cold sweat, hair-raising sensation in the scalp, goose-pimples, and feeling of being "shaky" or "trembly." In other words, a fear dream, like an imitation of the fear emotion, may be excited artificially by the introduction into the blood circulation of a minute quantity of the chemical substance adrenalin.

Adrenalin affects the sugar content of the blood. Insulin, the internal secretion of the pancreas, discovered in 1921 by Banting and Best, and now used all over the world in the treatment of diabetes, also affects the amount of sugar in the circulation. If too much insulin is taken, there is produced a feeling of restless anxiety, a presentiment of evil to come, which may be followed by trembling or even collapse. The sense of impending calamity and its consequences may be removed by taking sugar, either as lump-sugar or as that present in fruits like the orange.

In short, there is evidence that the spirit and substance of dreams may be determined by a disturbance of the chemical balance of the blood. I have followed the dreams of a number of patients under treatment with glandular extracts since I read the Finley report and have observed similar

results. As Slosson has suggested, it would have been edifying to have had a Freudian psychoanalyst study and interpret these dreams, after taking reams of notes about them, and to have seen him tracing them back to suppressed childhood experiences, or linking them with present wishes unfulfilled.

The action of adrenalin and pituitary in determining the nature and course of dreams provokes the question of how the glands of the internal secretion in general affect the nervous system, and so the personality. A host of data have accumulated from which it may be inferred that these glands regulate the growth, development, and functioning of the nervous system. Only a few of the outstanding facts can be cited.

Once in a blue moon or so a baby is born literally without brains; that is to say, without the great hemispheres of the brain through which sensation, memory, and will are mediated. Such babies sometimes survive for several months. It has been found that in these babies a portion of the adrenal glands, situated over the kidneys, known as the adrenal cortex, is either very defective or lacking. There is, moreover, a very great similarity in the chemical composition of the brain gray

matter and certain phosphorus-containing substances manufactured in the adrenal cortex continuously. It looks, in fact, as though the adrenal cortex provides the material for the building of the brain, as well perhaps as the material by which it renews itself daily. This view is reinforced by the fact that, just as the brain of man is very much larger proportionally than that of any other animal, so the adrenal cortex in man forms a much larger division of the gland, as compared with the lower animals.

Then there is the thyroid gland. Nothing is more astounding than the change in mentality, as well as in physique, achievable by supplying sufficient of the internal secretion of the thyroid to idiots or feeble-minded individuals suffering from a congenital deficiency or lack of that gland and known technically as cretins. (The word "cretin," by the way, is derived from an old Swiss word for Christian, which perhaps throws some light on the attitude of the unconscious toward Christianity.) Since the discovery and brilliant success of thyroid treatment in cretinism, a number of these children, once considered victims of a hopeless mental disease for which they could only be confined to institutions, have attained adult

development and experience, and move about their daily existence without comment from strangers or neighbors.

They pass for at least normal. And they are, except that they are dependent upon a supply of thyroid. The thyroid regulates the differentiation of the nervous system; that is, the unfolding of the convolutions and the growth of the different layers of brain-cells. If the thyroid is removed operatively, there occurs a degeneration of the nerve-cells, and the nervous system becomes infiltrated by a peculiar gelatinous substance which must interfere with the processes at the basis of consciousness. Without thyroid there can be no subtlety or depth of thought, no appreciation of beauty, no complex habit formation or behavior, no learning, no education—nothing that we recognize as characteristic of the cultivated soul or the sensitive mind. And not only that. Should the thyroid become suddenly or gradually defective, in one who has always been normal, even supernormal, there is a degeneration of the sensitive mind and cultivated soul. And this may occur at any time during the life cycle—in the twenties, the thirties, the forties, the fifties, or even later.

Nothing can be more convincing of the existence of a chemistry of character and personality than

to follow the transformations in a series of cases of thyroid deficiency at different ages. There is the change from the repulsive gargoyle of the coarse-haired, thick-minded, dumb, drooling imbecile to the silken-haired, smiling, intelligent, and educable child. There is the change from the lazy, stupid, slow, phlegmatic boy to the ceaselessly active, playful, sharp youngster. There is the change from the woman who finds herself being overwhelmed by a curious lassitude and drowsiness while she is losing her memory and becoming melancholy, into a woman who is again her old, keen self. There is the return to effectiveness of the man, say an attorney, who finds himself becoming intolerably bored by an abstract argument because he cannot grasp the fine points.

Even more interesting are the effects of the parathyroid glands upon the nervous system and the personality. These four little glands, each about the size of a grass seed, are placed two on each side of the thyroid. Their function primarily is to control the amount of lime in the blood and tissues. When they are removed, the body begins to lose lime and to suffer the consequences, for the less lime there is in the body the more irritable and sensitive it becomes. The nerve-cells of the brain lose lime and become more irritable,

so that convulsions occur often. The irritability of the nerves is increased, so that they will react to one tenth or even one one-hundredth of the amount of electricity necessary to stimulate them normally. Differences in the sensitivity between people, which we all recognize as an important difference in people, undoubtedly depend in part upon the parathyroid glands.

Connected with this function of lime and the parathyroids are certain other effects which have been discovered only quite recently. Human curiosity always directs itself first to the consideration of curiosities and abnormalities. Familiarity breeds not only contempt but also indifference. The strange, ally of the fantastic, possesses energizing and exciting powers that the every-day, immediately and repeatedly confronting lacks completely except to rare minds. Yet the history of science proves up to the hilt that the acquisition of knowledge has often consisted in seeing something that was directly in front of one's nose.

Only three years ago, a teacher in a public school for children in Marburg, Germany, noticed that a certain boy about eight or nine years of age in his class, when asked a question in geography—the placing of a city in a given province, for example—would concentrate his gaze upon a

wall of the school-room which happened to be painted a neutral gray, and then furnish the correct answer. It seemed as if he were actually looking at a definite representation of the subject under discussion. Nothing was there that could be seen. But upon being questioned, he admitted quite innocently, and also as if it were the most natural and usual thing in the world, that he actually saw the map in question, with all its details, upon the wall whenever he wished to recall it. This ability extended to pictures or printed matter of any sort. And he was much surprised to learn that this faculty, which he assumed was indeed used by all his fellow-schoolmates, was not so common as he thought.

Keenly interested, the teacher proceeded to follow up this accidental pedagogic discovery and found that a large percentage of his class were endowed with this faculty of "seeing things." A serious, scientifically conducted investigation followed, in association with a psychologist and a physician, the brothers Jaensch. Results of the greatest interest were obtained, with which one of the brothers Jaensch has in fact attempted to found a new psychology and a new metaphysics. But for us the light thrown on the relation of the physical and the mental is the only relevant mate-

rial. For the observations accumulated have demonstrated from a completely novel angle the dominating influence of the glands of internal secretions upon the chemistry and functioning of the brain.

And this is what they found and named the Eidetic Phenomenon, using, to coin the word, the Greek root meaning image. Individuals possessing the eidetic faculty might for convenience in discussion be called eidetists. The eidetist has the power to see again a literally correct and detailed image of a picture, a map or any visual representation, either directly after having seen it, or after the lapse of some time.

This ability does not consist simply in the power to visualize, which is the power to recall an image. Nor is it the normal so-called after-image in which complementary colors are seen which fade away quickly. The eidetist will see before him all the minute particulars and true colors of a picture after it has been taken away, no matter how complicated it may be. He may then notice details which escaped his attention when the object was in front of him. The images may return arbitrarily and so even become an obsession or source of fear, particularly at night, producing night-terrors. The faculty is not limited to vision; it may also be

true of hearing and touch, but is then much rarer (10 per cent of the cases).

Between the ages of nine and fifteen, 40 per cent of the pupils were found to be eidetists. In a number of others a much less marked but yet distinct development of the faculty was present. As the individual becomes older the eidetic capacity becomes diminished until at puberty it totally is lost. Sometimes, however, it persists. The life-histories of certain men of genius, Goethe for example, show that they possessed it to a marked degree in childhood and retained it to a great extent during adolescence and maturity.

Investigations followed to determine why these particular children had the specific faculty. Tracing the details of their diet, it was found that they were not getting enough lime in their water and food. At once this suggested the artificial control of the condition by feeding lime and a substance which facilitates the retention of lime in the body, cod-liver oil. As a result, the eidetic capacity of these children was discovered to be susceptible of control. When on the lime and cod-liver oil, they no longer possessed the capacity. When they were permitted to go without, the capacity reappeared. Certain of the children, who suffered from the night-terrors because of recurrence of

pictures they had seen in their books, were cured.

The eidetic capacity, it appeared, was a matter of lime functioning improperly in the body. It was then observed that these children exhibited a number of the signs of deficiency of parathyroid gland action. The association was inevitable, because a modern physician thinks immediately of the parathyroid glands when he comes across disturbances of lime in the body. Thus there was found a hyperexcitability of the nerves. It was also found that the eidetic capacity was present in its most florid form in the children whose thyroids were too active while their parathyroids were not active enough. When lime was fed to these children they lost the hyperexcitability of their nerves as well as their ability to "see things."

Although not generally present among adults, the eidetist faculty may appear in pregnancy, and the chief insanity of pregnancy is acute hallucination. Children who are eidetists tend to have delirium when suffering from infections accompanied by high temperature. They are often the brilliant scholars in the arts, but as rule they are poor in mathematics.

The coördination of the physical and mental, in which moreover the control of the physical means

control of the mental manifestations, cannot be better exemplified than in the eidetist and the cretin. But there are others. There are the children who present a curious intellectual precocity when the pineal gland is destroyed by a tumor. There are the children who present the signs of insufficient secretion of the pituitary gland (which like the pineal is in the head) and who lack inhibiting power and judgment, and are always getting themselves and their parents into hot water because of their lack of a moral sense and moral sensitivity, and so cannot be trusted. Certain of them land in juvenile courts as second and third offenders, delinquents and incorrigibles. These latter children have been transformed physically, mentally, and morally. Some of these children have been taken from institutions for the feeble-minded and restored to school and social life by the proper glandular treatment. This does not, by any means, signify that all feeble-minded children are suffering from glandular defects or can be helped by glandular feeding. There are children who are idiots because they lack a thymus gland, which is situated in the chest above the heart.

How intimately the sex-glands affect the whole personality has been well known from the earliest

experimental observations of animal-breeders. The differences between a rooster and a capon, between an ox and a bull, between a eunuch and a powerfully sexed man, have formed the subject of comment in all languages. To-day the data at our command are of the most diverse, lengthy and detailed. One fact, however, may be emphasized as clearly demonstrated, that the functioning of the sex instinct has been shown to be dependent upon the storage in the nervous system, in particular parts of the brain and spinal cord, of a chemical substance secreted by the sex-glands. Steinach calls the process the erotization of the nervous system. He showed that extracts of the brain and spinal cords of sexually active animals would erotize sexually inactive animals in a manner comparable with the erotization of such animals by direct injection of extracts of the sex-glands. It is interesting that it is possible to extract from certain portions of the brain, which are believed to be and are called the emotional centers, a substance having all the properties of pituitrin, one of the internal secretions of the pituitary gland, which we have seen has so interesting an influence in determining the color and the emotional tone and content of dreams. The fact fits well with the known curious emotional

apathy, the gentle placidity of individuals suffering from the effects of insufficient secretion of the pituitary gland.

Evidence, too, is accumulating that true homosexuality, like normal sexuality, is determined by internal secretion conditions in the organism. No one who has studied the queer quirks and twists of the mentality of the intermediate sex can fail to appreciate the profound effect of sex physiology on mental life.

In short, through the glands of internal secretion, we are beginning to get a glimpse of the chemistry of temperament. And who does not recognize the determining influence of temperament upon conduct? Already the great principles of a mechanics of character are shaping themselves for inquiring minds.

Are we then really chemical marionettes? And if so what becomes of our conceptions of responsibility and free will? I believe that these conceptions are pragmatic conceptions, made for use and limited by use. It all simplifies into the question of control. If our means of self-control increase as our methods of chemical control increase, there need not be any chaos of morality or any breakdown of elementary standards of sanitation, decency, or honesty.

The religion of control is as beautiful and moving as the religion of surrender. Its corollaries for conduct can be as imperative. The looming chemical control of ourselves daily becomes greater, is bound to become greater and greater and still greater as our knowledge increases, and will, without a doubt, make for the increment of human happiness and well-being, and toward the abolition of human suffering and torture. What more can we ask?

It is now in order to consider more closely those fundamental contributors to the core of the personality of Mr. X, the glands of internal secretion, as well as the nervous system.

CHAPTER III

THE INVESTIGATION OF THE PERSONAL

TO return to the individual who is before us for analysis. Realizing the tangled complexities of our problem, the question submits itself at once: What methods are at our disposal or must be invented for the completest investigation of this personality? Science begins with the determination of criteria and the scrutiny of methods. And the accuracy of our results will depend upon the accuracy of our handling of these criteria and methods. That deliberate accuracy, indeed, is what distinguishes the reports of science from the hearsay impression or romantic narratives of the man in the street.

There are a number of roads of approach open to us. There are, for example, the traditional internist methods of examination which we could have carried out for us by a reputable, entirely high-grade, properly trained specialist. There are the various methods used in anthropology. There are all sorts of psychologic tests of intelli-

gence and capacity and reactions. Rather quickly we should perceive that we were getting only a limited insight into the unique nature of our subject.

At the best, we should feel like a student of chemistry in the seventeenth century who might be studying water when its chemical composition was unknown. He could learn more and more about its properties: that it is wet, that it is colorless, that it will transmit light, that it will quench fire, that it will dissolve certain substances like sugar and salt and will fail to dissolve substances like sand or lead. But he would gain no insight into its actual nature and composition. It was not, indeed, until by analysis water was shown to be composed of two parts of hydrogen and one part of oxygen, that it was possible to speak of a knowledge of the chemical constitution of water as an entity.

The science of anthropology—which by definition is the science of Man—has achieved a technique for making measurements of various accessible parts and landmarks of an individual. Instruments, standards, and an array of statistics are at our command for measuring the shape and size of the head and face, the trunk and the limbs, and their relative proportions. A great

many data can thus be accumulated concerning the general build, the architectural style of the individual before us. Long heads and round heads, broad faces and narrow faces, long trunks and short trunks, thin bodies and squat bodies, long limbs and short limbs, which may be sized more or less accurately with the eye, may be subjected to exact measurements and the quantities obtained, noted, and recorded. Similarly the color, the pigmentation, of the skin may be studied and graded. The hair, its quality, texture, color, and distribution, may be minutely inspected and charted. But when we have all our data before us where are we then?

At best, the results may be subjeced to analysis by the comparison of the figures and the data and the organization of group-criteria for pigeonholing and classification, which is of course very desirable scientifically. But descriptive terms provide no insight into the nature and dynamics of individuals. Certain correlations of descriptive terms may be extremely valuable for practical purposes; for example, "corpulent" with "liability to diabetes," or "tall and slender" with "liability to tuberculosis." Biometric methods in themselves are acknowledged to have failed in heredity studies, when compared with the values obtained

in researches carried out with the intention of stating results in terms of fundamental units—which is the Mendelian method. Not that biometric or anthropometric studies are to be at all disparaged. But it should be recognized that as long as their results are not related to fundamental forces, the results are, as it were, a mere compilation of externals, of symptoms, which are the precipitations and manifestations of inner chemical reactions. Similar considerations hold good for psychologic tests. Intelligence tests are available for comparison of Mr. X's intelligence with that of the age group to which he belongs. Various traps and devices to catch the alertness and ingenuity of the individual's mind, more or less dependent upon his information as well as upon his mental agility, can be applied. And there are a whole host of tests at hand for use in vocational examinations and guidance and in the selection of particular employees for particular purposes. If we should wish to employ Mr. X as a chauffeur, there are certain tests that are obviously useful and significant, as one for caution in driving, and another for speed in reacting to signals of danger, and another for decisiveness. But what regulates the speed of reaction and decision, such tests naturally will not reveal.

Although the influence of the sex-glands, or, more properly speaking, of the deprivation of the reproductive organs, upon the individual characteristics of animals and human beings, had been known for centuries, and although numerous pioneer observations and speculations antedated it, it was not until Charles Edouard Brown-Séquard read a famous paper before the Société de Biologie of Paris on June 1, 1889, on the effects of injections of sex-gland extracts, that the far-reaching possibilities of a chemical mechanics of personality determination became manifest. Three years before, Victor Horsley in England had published a paper on certain "functional nervous disorders due to loss of thyroid gland and the pituitary body" in which the influence of these two glands upon the metabolism and condition of the nervous system was suggested. But the positive statement of Brown-Séquard concerning the effects upon various bodily and mental functions, such as appetite, physical strength, mental energy, and ability to concentrate, channeled the territory for an ever-widening river of research and investigation.

Yet, although Pierre Marie published his observations on the effects of the pituitary gland in the disease acromegaly upon the bodily pro-

portions, and Murray two years later, in 1891, published clinical observations on the personality modifications of the administration of thyroid gland, no attempt has come to my notice of the construction of a fundamental chemical theory of individuality for the next twenty years. In 1912 a German, R. Stern, published a monograph entitled "The Bodily Characteristics of Predisposition to Tabes," in which, basing his conceptions upon a careful study of individuals suffering from the diseases of the nervous system, locomotor ataxia and general paralysis, which sometimes develop in syphilitics, in which he definitely voiced the conception of a "polyglandular formula" as determining differences in form and function between individuals, as well as differences in resistance to disease and possibilities of infection. He compared different individuals with those suffering from thyroid and pituitary gland affections of their personality and declared that glandular differences in normal individuals could be deduced from variations in their construction observable even in childhood and during adolescence. He also emphasized that the variable contributions of the different glands of internal secretion to the make-up conditioned not only form and function variations, but also receptivity toward disease and

the character of disease as it developed. In the same year the Italian Nicola Pende read a paper before the Congress of Internal Medicine in Rome in which he compared various types of body build with types established by glandular dominance and used the term "individual endocrine formula." As in the case of so many of the cardinal ideas of the sciences, it was as if a solution was waiting for some particle of disturbance to permit a great crystallization. Many minds all over the world were affected by the great conception of an endocrine-chemical determination of the anatomic and functional properties of human beings.

But—besides the influence of the glands of internal secretion upon temperament and physique and such individual and racial qualities as skin texture and coloring, hair quality and distribution, cranial and facial bone development, therefore including head form, which is a primary interest to the student of races—the large issues of intelligence and temperament, as well as individual and racial vigor and vitality, come within the endocrine domain. As also does the mechanics of the appearance of those abnormal variants who have influenced the course of culture and history.

One of the great achievements of modern science

has been the release of thought from the theological dogma, even now accepted as gospel truth by hundreds of millions, that the personality consists of the manifestations of a "soul," a reality which is made of "spirit," opposed in its nature and activities to "matter," and consequently to the "body," palpably flesh and blood. In the past the scientific attitude has done good destructive work and paved the way for more rational conceptions. Not until quite recently, however, has it substituted any really satisfactory and useful data for those it demolished.

A number of thinkers of the seventeenth, eighteenth, and nineteenth centuries evolved, partly out of their inner tough-minded consciousness, and partly with the aid of the scanty knowledge at their disposal, mechanistic theories of human conduct. It was very bold of Thomas Hobbes in the seventeenth century to proclaim that the behavior of a man was simply the expression of his instincts. And the most daring of succeeding thinkers defied the gods in their heaven and the occupants of the seats of the mighty on earth when they declared that a man was just a machine. The substitution of the word "machine" for the word "soul" was a mental revolution. But it was an empty conception, because there was no con-

crete information at hand to supply the parts for the assemblage of the machine.

When Freud and his disciples appeared and showed that, with the help of certain assumptions and terms, a good many puzzling human reactions could be understood and riddles solved, there were those who shouted that a true mechanics of human nature was upon us. But it was not until the rapid accumulation of facts concerning the relation of the glands of internal secretion, producing substances which entered the blood and reached every part of the body with the blood, to the entire make-up of the individual, and especially to the nervous system, before birth, and during development, adolescence, and maturity, that we may be said to have attained real knowledge concerning the basis of important, practical variations in individuality.

That certain disease proclivities run in families is an acknowledged principle. Also there is a greater predominance of certain diseases in particular races, like diabetes and its complications among Hebrews, gout among Anglo-Saxons, rickets among the Latins and the negroes when transplanted. These point to the existence of an innate factor in disease; namely, the composition of the individual. Disease will take root only in

human material of a certain quality, as certain seeds will thrive and bloom only on specific soils. Thus the study of disease may be made to give us various insights into the secrets of personality.

Personality does not mean temperament alone, or mind alone, or particular dynamic peculiarities alone. It is used as the best term available to embrace the ensemble of traits that combine to make the individual different from his fellows. It designates the unique qualities of the individual at rest, and when in action (when normally functioning), when in reaction (in conflict), and when living within, feeling, willing, being, and becoming, or, to use an ancient but honorable and indispensable word, his "soul." When we look upon the individual at rest we become aware of him as a subject of anatomical inquiries, with structural lines and variations in the material; the bricks and mortar of his architecture, so to speak. When we regard him in action, with each part functioning, we contemplate him as a subject of physiology. When we observe his reactions toward stimulating or depressing agents, toward causes and conditions, provoking conflict, multifarious and varying from the germs of disease to the complex problems of civilized life, we enter the domains of pathology and anthropology. And

when we look upon him as a striving, suffering, doing, craving, knowing, willing spirit, when we put ourselves inside the stream of his consciousness and attempt by a sympathetic act of the imagination to see with his eyes, to feel with his nerves, and to dominate with his will, we are viewing his mental life.

Thus there are three sides or facets to every individual:

(1) The structural, which relates to the way he is built and the different materials out of which he is made.

(2) The functional, which reports how the different components of his make-up are working, including the reactions to stimuli, the reply to various agencies in the environment, exciting or sedative, injuries and infections.

(3) The psychic, the mental and spiritual characteristics and tendencies, as they develop, and during maturity.

Utilizing this tripod of the personality, we are enabled to group the facts pertaining to an unknown, friend or enemy, friend or lover, relative or employee, whom we wish to study.

In collecting our information we make use first of whatever we can obtain by inquiry of our sub-

ject and his associates regarding his past history in these aspects of himself. Then by means of the senses and such simple instruments as the yard-stick and tape-measure and watch, a record is elicited of present conditions and findings. These in turn are supplemented by examinations of the blood chemistry and so on. In the record of tendencies, there results thus an accumulation of individual peculiarity, abnormality, ailment, or disease. There becomes visible a pattern, a general type plan according to which the subject has been constructed by nature. The coloring of his skin, a tendency to become easily fatigued, or frequent attacks of tonsilitis, different and unrelated as they may seem at first sight as personality traits, should all fit into the picture, like the various parts of a Chinese puzzle.

In beginning the collection of data, it is valuable to recognize that there are characteristics which are of interest to us as running in families, and therefore probably expressing some peculiarity in the family germ-plasm. That blood will tell is a popular statement of this fact. We, therefore, inquire first concerning how the viewpoints we have adopted may be applied to the family. Information concerning the characteristics of the family, the father and mother, and the brothers

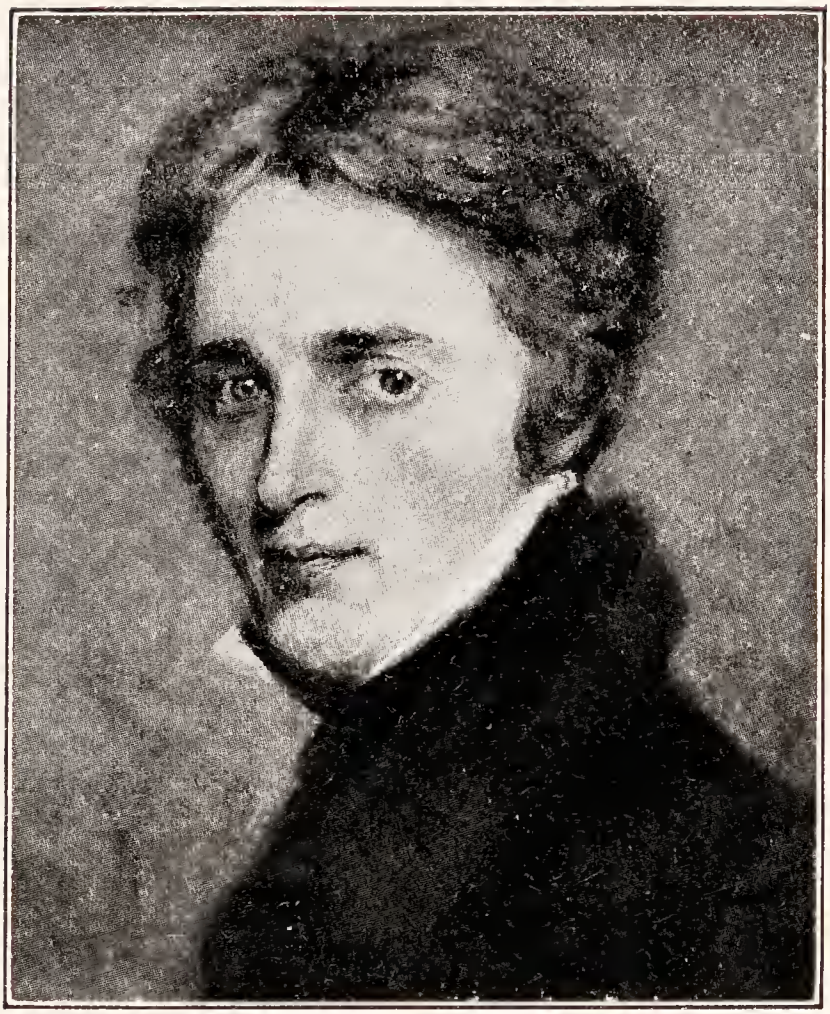
and sisters and other relatives, becomes interesting. One desires to know whether they show any tendency to peculiarities of shape and size, the occurrence of giants or dwarfs or freaks of any kind. From the functional side, it is of interest to discover the general trends concerning growth and development, menstruation and pregnancy, and various degenerative diseases. From the psychic side, the general temperamental trends.

That there is a family slant in those matters is contended by popular opinion and confirmed by the researches of both physicians and students of heredity. Davenport has demonstrated the inheritance of temperamental trends. Karl Pearson was the author of a famous paper on the inheritance of physical and mental characteristics. It should always be remembered that, as regards most traits, heredity determines only direction. The degree or quantity of development of a trait, in other words the amount which it travels along the particular direction, is determined by a number of factors in the make-up which are to concern us later. Charts are available from the United States Bureau of Eugenics which assist in complete registration of significant ancestral facts.

After considering the family, we come to the analysis of the qualities of the individual before

us. He is the outcome of a bundle of forces determining the form and function, strength and weakness, of his body and mind. But before considering these in a particular individual case, let us review the family history to illustrate our method in detail in an actual instance. Then we may go on directly to the individual himself.

The man before us is a poet. The maternal grandfather was the ruler of a European duchy. The maternal grandmother was an actress, brunette, petite, brilliant, passionate, and died of diabetes at an early age. This occurrence of diabetes in the direct ancestral line suggests some familial tendency to disturbance of the glands of internal secretion. The subject's father was darker than the subject himself, much taller and more impressive, handsome, and died of heart-disease. The mother is also dark, in fact swarthy, with brown spots scattered over her face and hands, is rather excitable, and has had a number of nervous breakdowns. This points again to some lack in the chain of coöperation of the glands of internal secretion, as it is being recognized more and more frequently that the disturbance of physical and mental coördination, which is at the bottom of the so-called nervous breakdown, is an internal secretion phenomenon. It is most often a break-



Percy Bysshe Shelley

Exhibiting the features of a thyroid-pituitary centered individual

down of the adrenal glands. The swarthiness of the complexion, together with the presence of brown spots, points to the existence of disturbance of pigmentation, a matter regulated by the adrenal glands. The mother suffers severe headaches, often of a periodic type. We may, therefore, conclude that there is evidence of instability of the adrenal glands in the ancestry.

The subject himself has suffered a loss of creative ability, accompanied by an aggravation of periodic headaches. He is author of several books and is also a controversial journalist. He was born in Austria and was a premature baby; that is to say, he was born at seven months instead of nine. That should suggest at once a deficiency in the glands of internal secretion as well as in the organism's handling of the salts of iron and lime. It is in the last three months of life in the womb that a great deal of iron and lime are deposited in the tissues. An individual born in the eighth month lacks more than 20 per cent of the normal iron and lime. One born like our subject at seven months is even more handicapped, particularly as regards lime metabolism and the consequent strain upon the parathyroids.

He had no trouble with the coming of his teeth, or with talking and walking, probably because he

was kept on breast-milk for a long time. Ordinarily, premature infants develop rickets and anemia because of lack of lime and iron. Breast-milk, however, is the best corrective for these deficiencies, when supplemented by iron and proper conditions of hygiene. In fact, he began to walk and talk early, a manifestation of precocity, and he also began to develop mentally rather early. Yet he remained rather short throughout childhood.

He was an only child and was naturally pampered. He hated exercise and always evaded it. Though he was sent to a kindergarten at the age of three, where he exhibited precocious mental brilliance, he could never learn to dance, although most of the children of his class learned easily. At games he was poor, and, indeed, at any effort which involved mechanical skill or muscular coordinations. The pineal gland is involved in muscle development and functioning during the first six or seven years of life in a very important way. X-ray examinations of the head showed a very marked deposit of brain sand in the pineal region, possibly dating back to early childhood, and meaning an early atrophy of the pineal. This conclusion is aided by the occurrence of a distinct mental precocity, which he says was observed by

every one who knew him at the time. That the second teeth came in rather soon also confirms the inference. An early involution of the pineal favors sexual precocity also. He says that true sexual feeling was aroused in him at the age of three, and continued through the ages of four and five, the age when he began to masturbate. Between the ages of six and twelve he fell in love, quite romantically, with several girls and experienced acute sexual desire for them. At the age of eleven he had a romantic episode with an English governess, which, however, merely caused him to masturbate more. He had intercourse for the first time at the age of sixteen. After several affairs with women, he began to experience homosexual desires. Whether this was merely a matter of suggestion and curiosity or a distinct craving at the time, he cannot say. At any rate, there were several stirring relationships with men, which never went beyond mutual masturbation. He is now thirty-two years old, married happily about seven years ago, and has three lovely, healthy children; but sexual intercourse is never of the intense orgasmic type, nor has it ever been.

This sexual history in an individual in whom the pineal diminishes in influence too early and greatly in the first seven years of childhood is as

interesting as his intellectual history. From the age of four or five he felt himself a rebel against society, its conventions and compulsions. He felt, too, that he was different and made of a superior clay. Very early he began to compose verse, at first in German, later in English. He is not good at free-hand drawing, nor does he like music, but still he considered himself an artist even before adolescence.

The precocity of the mental attitude toward life of these pineal-disturbed children has been described in a number of instances. That is what should be emphasized, the precocity of knowledge or intelligence. There is a distinctly more somber, more mature outlook upon life and its problems. Thus this man, maturing early, was never able to do anything but poor work in mathematics and the sciences. In the arts, likewise, he was a failure; he was no good at drawing, and had no ear for music, which he has never liked. But attempts at verse-making in his native tongue were early; and after he came to this country they were made in English. This he made his life-interest, and he attained some distinction. He has always had the poorest of memories for faces and names. An intellectual discussion is futile to him. He

prefers intuition to logic, and his own lyrical instincts to the evidence of the senses.

Other points throwing light on his history are the following: With adolescence, which was a little ahead of the average (he began to shave at the age of eleven), he began to have severe headaches of the migraine type. These have continued to the present time. He grew rapidly to his present height during early adolescence. The character and situation of the headaches suggested involvement of the pituitary gland. Lately the headaches have become more severe and have been accompanied at times by pains in the bones or cramp attacks in the abdomen. His teeth have become very soft and brittle, so that he requires the constant attention of a dentist, who tells him that small cavities form almost continuously in the upper molars. At the same time, his creative power and the controversial vigor of his writing have materially decreased.

When questioned concerning his natural personal traits, he admitted periods of craving for sweets, at which times he would eat as much as a pound of chocolates or other candy at one sitting. He also emphasized a craving for water and a recurrent thirst in the evening. He does not care

for alcohol, tobacco, or meat. To oily and fatty things he is indifferent, but he is rather fond of fruits and vegetables. In the last few years he has found that he can enjoy nothing thoroughly and is always tired and often sleepy, particularly after even the lightest meal. He had increased his weight by twenty-five pounds in the last ten years. Other points bearing upon the story are that he does not perspire easily, that constipation has been a lifelong difficulty, and that he has lately become subject to outbursts of temper.

All these details may be paralleled in the life-story of any such individual. By piecing together whatever information one can glean concerning a man's ancestors, direct and collateral, concerning their appearances, careers, adventures, and diseases, a complete picture of our hero's ancestral personality may be reconstructed. Back of that, if certain strong traits of physique, pigment of skin, build, temperament, or general disease tendency stand out in the family annals, one may suspect the existence of dominating chemical forces in the family germ-plasm such as an over-acting thyroid gland or an insufficiently functioning adrenal gland. The inquest into the relatives forms, then, always the prologue to our inquiries.

The individual himself, as a historical person, a man or woman, with a past, is the product of a more or less progressive development, the outcome of an evolution. This evolution is the result of the interaction between himself, a chemical system somehow impregnated with the memories of his ancestors, and the milieu, the circumstances, the conditions, in short the environment, in which he finds himself or which he makes for himself; although technically, theoretically, and often very importantly, this interaction begins at the very moment at which the fused egg-cell and sperm-cell commence to breathe, that is to say, to oxidize in the womb of the mother. All his evolution, his metamorphoses and reactions to his contacts, the story of the smooth or rough course of the normal and abnormal happenings of his existence, must being with that fateful introduction to the air of the earth which is known as birth.

The inquiry into the historical person begins, then, with him as a baby. The inquirer would know his weight and condition at birth, as well as all the circumstances thereof. All the details of the infancy, the breast-feeding or bottle-feeding, all the accidents and diseases, thriving progress or stationary stagnation or retrograde pushes of malignant bacteria or maternal ignorance; all

these are important. Even those events, so formidable to the Victorian grandmother, the coming of the teeth, must be regarded with respect. The first dentition, like the second, is the expression of a chemical crisis in the organism, a revolution in metabolism. In the chapter on the influence of the glands of internal secretion in children, the significance of the normal and abnormal data concerning dentition will be considered at greater length.

Childhood is the history of the physical, intellectual, sexual, and spiritual becoming of the personality. Character emerges as a by-product of that becoming. It is the task, then, to trace, as accurately as one can, the step-by-step or saltatory mutations and indications that furnish the material for the vision of the investigator. A certain amount of imaginative insight and sympathy is here an absolute necessity. To place oneself alongside the stream of consciousness of the child, adolescent, and adult, to grow with it, experience with it, react with it, is the privilege of ourselves as observers. Imaginative literature like the novel, the play, the poem, will assist in particular the student of the transmutations of the physiological into the psychological.

Chromosome *vs.* circumstances, fate *vs.* chance,

even cunning *vs.* luck, as Samuel Butler loved to put it, are strictly reducible to the formula of substance *vs.* conditions. Therefore, in the baby, in the runabout between the coming of the milk-teeth and the permanent teeth, in the school youngster, in the flapper, male and female, in the normal, subnormal, or supernormal good or bad citizen, the spectacle presented for scrutiny or analysis provides evidence for deductions concerning the quality and quantity of the stuff of the personality.

The rate of physical and mental growth and experience during the runabout period between two and seven, the adventures of the school periods, the subjects that were spontaneously liked and easily mastered, or intensely hated and poorly assimilated, the reactions to the system of marking as well as to the social possibilities and necessities of school life, the blooming of an interest in sex, the time and intensity of pubescence (which means literally becoming hairy), and the concomitant profound transformations of the whole being; all these should be recorded, and the distillate, as some sort of conclusion regarding each epoch, should be preserved in the chart.

In the child, as well as in the adult, we are interested in ascertaining any temporary or perma-

nent aberrations of function. Headaches, indigestions, recurrent colds or attacks of tonsilitis, a tendency to rages or bursts of temper, any so-called "little peculiarities" of conduct or reaction, all are important as representing expressions of the great underlying forces which make the individual what he is, utterly different from his fellows, and perhaps changing him to-morrow into a being utterly different from what he was yesterday.

It is important, too, to follow as closely as possible his environmental development. For it is peculiarly true that the first seven years of life are the hardest; the most difficult, that is, for the tender mind and soul that has still to bloom in adolescence and obtain the tougher fiber of maturity. One wishes to know, therefore, how much chance for self-expression our examinee has had in childhood, how much thwarting, and how much gratification of inherent desires, hopes, and joys. Particularly pertinent are vague or specific fears, especially when built around some definite experience or experiences. Dim half-faced fears may be even more significant to trace than those that were conscious and directed toward some real object or person. Natural tastes, and likes and dislikes in food, friends, amusements, and interests,

are invaluable, because there may be a metabolic explanation for even these selections.

When we have collected all these facts bearing upon our subject as a Historical Person, as an individual with a history and a psychology or what perhaps may be best put as a biography, it becomes possible to obtain the maximum of significance and interpretation out of the body and mind facts that can be elicited by the various methods that may now be applied.

All human beings are experiments in the great laboratory of nature—nature, not as a beneficent or maleficent goddess, but as the inadequate title for all those intersecting and interacting forces whose ensemble constitutes the individual. There are a series of possibilities to consider which may be enumerated in reviewing what has made him.

A gene in a chromosome changed or displaced—something physical or chemical happening to the daughter cells, the immediate products of the subdivision of the original mother cell; or an accident touching any one of the three great cell layers into which the daughter cells proliferate. The great outer layer, the ectoderm, develops into the skin and nervous system. A little incident in it may record itself later in a great birthmark that may deface a face or an arm. The great inner layer,

the ectoderm, proliferates the alimentary canal and its appendages. Some local quirk, occurring for one reason or another, may change the whole course of events, providing favorable conditions for a fatal attack of appendicitis twenty or thirty years later. The middle layer, the mesoderm, forms various internal organs and their coverings. Weakness in their structure and stamina may be traced to a disturbance occurring early in its evolution. All these great primitive cell layers contribute to the making of the glands of internal secretion, and similar considerations hold regarding them. A lifelong tendency to overaction or insufficient action of any one of them may be attributable to a local change in a cell layer occurring when the individual, looking like neither fish, flesh, nor fowl, was only a few weeks old. These, however, are relatively rare when compared with the actual, the known, which occur in the fully evolved or evolving glands because of either defective diet or disease of the mother before birth, or environmental, food, or disease agencies acting after birth.

Then, in studying a particular character trait, physical or mental, we are confronted by the question: What and how much has been the contribution of externally determined changes in the prim-

itive cell layers? What is to be put down to differences in the mother's chemistry during pregnancy, the outcome of circumstantial or feeding defects or internal glandular difficulties in her? And, finally, how much to the influence upon the individual's own chemical apparatus of factors in the environment like heat and cold, moisture and dryness, food elements like the relation of the starches to the vitamines, the amount of ultra-violet rays in the atmosphere, and a host of others, reflecting and producing the inherent inadequacies or super-adequacies of the glands of internal secretion.

Every possible method is utilized in attempting to answer these questions with the limited information and conceptions at our command. Familial analysis, collection of the common traits in collateral lines, as well as in the third and fourth and fifth generations, careful study and examination of the mother (interest centering upon the changes occurring in her during pregnancy), as well as the interpretation of the evidence presented by the individual himself—all these must be searchingly and critically surveyed to yield data available for a synthesis which will be a pictorial film of the constitution and dynamics of the personality.

CHAPTER IV

THE CORE OF THE PERSONALITY

SOME years ago a woman of English ancestry, about thirty-five years old, occupying a prominent position in the political and social life of New York, perceived an insidious transformation of her personality occurring. Always a live wire, known among her friends as Mrs. Pep, and possessed of a personal magnetism which made her the life of the party at any gathering, she found that gradually she was losing her interest in the general spectacle of existence, and that her vim and snappy responsiveness to her environment were going. She found herself slowing down, becoming fatigued in the early morning hours, a symptom specially alarming to one who had always awakened with a feeling of singing and dancing at the glories of a new day. Above all, she noticed an increased need for sleep and a desire to fall asleep late in the afternoon. She began to put on weight, and in the course of about a year she put on about twenty pounds. As she was

naturally tall and slender, there was no perceptible increase in her avoirdupois. For a time she neglected that symptom also. When a slight but curious thickening of the skin of her forehead and the back of her fingers and hands developed, she became genuinely disturbed.

Careful examination, confirmed by laboratory data, pointed to an incipient deficiency of the thyroid. Under treatment, there was a recession of the symptoms and a restoration of the previous charming, active personality. No adequate explanation was obtained for the onset of the condition except that three months before this there had been a miscarriage.

At the same time a gentleman of her acquaintance about twenty-eight years of age, had been undergoing a similar change of personality. He, however, had a different story. About a year before he had undergone an attack of encephalitis, or sleeping sickness, which at that time was relatively epidemic in New York. After a period of fever and lethargy, he had shown various symptoms for about three months, all of which eventually completely cleared up. Three months after the disappearance of the symptoms, he noticed that he was getting fat. Simultaneously he began to lose hair from his face and from his arm-

pits. The obesity seemed to increase by leaps and bounds day by day, so that in the course of six months he had doubled his weight. In a parallel fashion there was a metamorphosis of his spiritual self. He had been a light, agile, outdoor young man, who went to all the first nights of the new plays, took in all the new picture-shows, went to every significant concert, dined out every evening, and, besides, had the energy to dabble in politics. Now he was another man. He preferred to stay quiet; his face assumed an expression of placid self-complacency; his speech was slow, deliberate, and often halting; he was content to pass his days in gossiping about nothing in particular. Even his handwriting had changed in the most remarkable way, so that bank-tellers questioned the identity of his checks until a new signature was left at the bank. Also he had become impotent.

Examination of the nervous system showed no signs of any lesion anywhere. There was no paralysis, no disturbance of the reflexes ordinarily tested. Neither could any evidence be obtained of any disease or disturbance of the glands of internal secretion. Examination of specific reflexes of the type known as psycho-galvanic showed that there was abnormality in the functioning of the portion of the nervous system which is known as

the vegetative, as distinguished from the animal nervous system, because it controls the vegetative functions of the organs, nutrition, rhythm, and automatic self-regulation. The animal nervous system controls what distinguishes the animal from the plant or vegetable, movement and sensation and their combinations in memory, imagination, and thought. It was, therefore, decided that the virus of sleeping sickness had successfully attacked and damaged certain vegetable centers in the midbrain which have to do with the consumption of food and energy, with the tonus of the genital organs, and with emotional tensions in general. For a time these centers had struggled to carry on their function in their damaged state, but they had finally yielded to the forces of degeneration. Thus obesity, apathy, and impotence had in six months transmuted the being of the young man about town.

These two strange cases exemplify two possible methods by which nature changes personality. Analysis of hundreds of instances of such changes in the last ten years, when knowledge of the function of the glands of internal secretion in the body and the vegetative centers in the great basal ganglia of the brain has greatly increased, has demonstrated the presence of injury or im-

perfect or unbalanced action of one or the other.

But one must never forget that besides being an organism functioning from within, there is for every individual a mental life dependent upon stimulation from without. In other words, every individual has experiences. These experiences are specific and unique for him. They leave traces which organize themselves in the process of memory. A remarkable structure is thus evolved which is the basis of the psychic personality. No one can deny the effect upon the personality of such every-day experiences as grief, disappointment, or defeat, or victory, joy, and encouragement. That nothing succeeds like success is as true as that nothing fails like failure. The influence of education, of philosophy, of religion, of all multiform suggestions of environment upon the personality can never be ignored. Comedies and tragedies of the personality may take place upon the psychic plane only.

The influence of the mind upon the body has been discussed from prehistoric times. And practical applications have been made which worked not because of the wrong theory but the right practice. Studies of the last few years have demonstrated up to the hilt the importance of past experiences in determining the onset, the course,

and the outcome of that disease which is par excellence a disease of the mind, hysteria. And the case-histories of "conversions" which occupy the pages of William James's immortal "Varieties of Religious Experience" provide sufficient concrete data of every sort bearing upon the subject. An unpleasant experience, a strikingly intense experience, an extraordinarily moving experience, may rarely cause a complete transformation of the spiritual outlook upon life, and, it would seem, of energy production and distribution in the body by means of the mysterious links which put glands, nerves, and experiences en rapport.

A story like the following may be regarded as characteristic: A young painter, handsome, clever, even called brilliant, healthy, with the most promising future in the world before him, married a débutante who had received a complete education as educations go, and who was acclaimed everywhere among those who knew her for her beauty and charm. The marriage was one apparently based upon love at first sight, intensified by the revelations of companionship. The alliance seemed classifiable as one of Hymen's masterpieces.

Against that assumption of a rare ideal state of matrimony loomed a latent but fundamental dif-

ference in temperaments. The husband was of pure New England ancestry, proud of it, and also the recipient of several prizes at Julien's and the salon exhibitions in Paris. In a generation inclined to scoff at family pride, while it listens respectfully to the solemn pronouncements of the Mendelian eugenists, he was the silent champion of family honor. The wife, financially independent as an heiress and also as a woman of considerable intelligence and ability, was one of those women of whom so many are extant to-day, who preached but never practised the new feminine freedom—drinking, gambling, swearing, and petting in public. So obviously was she a theorist in these matters that her future husband accepted them as the fashionable vagaries of the spiritual atmosphere she breathed, volatile constituents of the air which she inhaled in common with so many others. She was born in New York, a mélange of Dutch, English, and Spanish blood.

For two years the arrangement was a success. Then a catastrophe occurred. One evening the lady gambled away a large sum of money at bridge. It was the first time that had ever happened. The next day she related the episode to her husband as rather a good joke. He became infuriated, and, as the matter was euphemistically

put by a narrator, he resorted to discipline. No one could ever say just what means he used. That evening the woman was found in the bath with her wrists slashed. The suicide was hushed, and the absence of publicity confined the scandal to those on the inside.

The effect upon the husband was drastic. Overnight he seemed to have lost all self-respect. There was a complete breakdown of the code according to which he had lived and worked all his life. For nearly two years he was almost continuously drunk. All his commissions and engagements were neglected and unfulfilled. Hopeless slovenliness and indifference emanated from his clothes and manner. He became fat and soft; in short, his whole personality went to pieces. A slow emergence from this state of will-anarchy finally landed him as an instructor in an art school. No specimen of creative activity has appeared since the tragedy.

The case, simple and incredible as a melodrama, illustrates what an effect an experience and its after-realization as an irremediable fact may have upon the personality; there are plenty of such cases present in every one's acquaintance. It is important for the simplicity of its elements.

It is certain that there was no undercurrent of

sex, of either the Freudian or Balzacian kinds, as the two were perfectly mated sexually, and there was no question of a triangle, either accomplished or latent. Moreover, there is no need for a subterranean probing of motives and reasons. True, the contrast between the fine austerity of the husband and the delightful worldliness of the wife might provide some food for the appetite of amateur analysis of the subconscious. The fact remains that if the woman had not committed suicide, the whole thing probably would have blown over, with none of them the worse except a little more educated regarding the incalculability of human reactions. It was her act, as an incurable, irreparable experience in his history, that smashed completely his code of values, and so his life and personality. The whole emphasizes clearly the influence of experiences as psychic events upon the history of the personality.

These three actual transformations exemplify the possible modes of changing a personality. A change in the glands of internal secretion, an injury of certain portions of the nervous system, or a specific experience or experiences are what we find, as a matter of fact, without prior theoretical considerations, in studying instances of personality transformation. It is upon glands, nerves,

and experiences that we can put our finger in particular cases as the causes of such mutations.

Moreover, in the modern view, glands, nerves, and experiences react and interact as parts of one great whole. It is sometimes extremely difficult to trace the chain of sequences, and to say which came first, an alteration in the endocrine glands, a deeply undermining modification in important mechanisms of the nervous system, or a shifting and shaking of the foundations of experience. By the application of various criteria and tests, the distinction may be made even in border-line conditions in a sufficient number of examples to enable us to speak of them with scientific accuracy.

Nor are we to distinguish between "glands" and "nerves" as "body," and "experiences" as "mind." Just as Einstein has shown conclusively that differentiation between "space" and "time" is a fallacious trick of a certain practically valuable but really wholly artificial mode of thinking and that we should rather speak of them as a "space-time" or "time-space," so it is driven home by every new discovery in the physiology of the relations of the body and the mind that we should speak and certainly always think of "mind-body" or "body-mind" as aspects of a unity like the inside and outside of a glove.

Just what are the glands of internal secretion (or, as they are also known, the ductless glands, or endocrine glands, or simply the endocrines)? They are organs, in the sense in which the heart is an organ or the lungs are organs. That is, they are devices or machines for doing a definite type of work in the body. But whereas the heart and the lungs are essentially organs for doing mechanical work, the heart pumping the blood through the channels for its distribution where needed, and the lungs acting as a species of bellows for the intake and outgo of air, the glands are essentially organs for doing chemical work; that is, for the production of specific chemical substances important in the most subtle of the continual changes which constitute life as distinguished from death. These specific chemical substances are known as the internal secretions because they pass into the blood-stream, thence to be transported to the places where they serve their purposes.

Those which are known and whose function has been worked out fairly satisfactorily are (1) the pituitary in the head, in the floor of the skull, (2) the pineal in the brain and forming part of it, (3) the thyroid in the neck just above the windpipe,

(4) the four parathyroids, at the side of or near the thyroid, (5) the thymus in the chest below the breast-bone, above the heart, (6) the adrenal glands, one on each side above the kidneys, (7) the pancreas or sweetbread, below the liver, which may also be classed as a gland of the internal secretions (but both the pancreas and the liver also produce prominent external secretions—bile from the liver and pancreatic juice from the pancreas—without which digestion is impossible), (8) the reproductive or sex glands, ovaries in the female, testes in the male, for which has been coined the convenient common term "gonads."

Each of these produces secretions, specific chemical substances, also known as hormones, peculiar to itself and not producible in any other. Therefore, one cannot substitute for the other, and each is absolutely essential for proper and adequate development and functioning of the various parts of the body-mind. Beginning with the primary and fundamental function of food digestion, distribution, mobilization, combustion, and transformation into energy production, going on through the functions of the circulation, respiration, and locomotion (all involving nerve activity and muscle movement), up to the highest functions

of emotion and intellect, they play a regulating and controlling rôle like the mainspring of a watch.

Upon the nervous system, too, as the organ of the registration of experiences and of the mobilization of past experiences to meet present and future ones, they exert a dominating influence. The nervous system consists of the vegetative nervous system and the animal nervous system. The animal nervous system has to do with sensations received from the external world and voluntary muscle movements made in response to them, and with the traces of sensations and movements known as memory. The vegetative nervous system has to do with the coördination of the organs boxed in the chest and the abdomen, in peace and in war.

In peace, in normal comfortable functioning, each organ with its nerve-fibers and nerve-endings must have a certain tone, a certain tension, which means crudely a certain strength. So, for that matter, must all the muscles with their nerve fibers and endings, and the nerve-cells of the spinal cord and the brain itself. The efficiency, the effectiveness, of every cell is proportional to its tone, when the balance of forces is normal, that is when there is no disease with its sense of

lack of ease. All other things being equal, the normal healthy tone of cells and tissues depends upon the concentration in them and in the blood of the internal secretions.

In war, in critical times of stress and strain, when the body-mind must fight or flee, must kill or be killed, or when it is flooded by the needs and emotions of anger, or desire, or sex, the vegetative nervous system distributes the blood to the places where it will be most needed, and activates and increases the tone of the cells that are to be most active in the situation; for example, the brain and the muscles. The internal secretions are poured into the blood in greater concentration to act more powerfully upon the tone of the nerve-cells and the muscle-cells, as well as to change the chemical composition of the blood, like increasing its content of sugar from which energy can be evolved most quickly. The outcome, success or failure, survival or destruction, satisfaction or thwarting, expression or repression, may thus be traced back to the varying capacity for response of the glands of internal secretion.

In peace and war, it should always be remembered and repeated, each gland has its specific functions, influences, and effects carried on for it by the particular chemical substance or hor-

mone which it is continually manufacturing in small quantities.

The pituitary gland really consists of two glands, one behind the other, bound together into one mass, located in a little bony cup formed in the floor of the skull, in the mid-line, at about the level of the root of the nose. Conventionally, the two glands are distinguished as lobes; the one in front, the anterior lobe, has been designated as the pre-pituitary gland, and the posterior lobe as the post-pituitary gland. The use of these terms is becoming a necessity, as evidence has accumulated that each lobe produces a wholly different secretion, entirely distinct from the other in chemical composition and function.

The secretion of the anterior lobe or pre-pituitary was recently obtained in soluble form, and by means of it giant rats have been created. In human pathology giants have been found the results of its overaction before puberty. This is because of its stimulating effect upon the growth of the bones, especially the long bones. If the overaction occurs after puberty the heavy-boned robust large type of individual is produced. The pre-pituitary also has a great influence upon the proper evolution during development of all the other glands of internal secretion. After puberty

it has much to do with the growth and proper maintenance of tone of the sex glands throughout life. So when it fails to act during maturity the sex glands atrophy, the hair of the face is lost, as is that in the arm-pits, and strength departs. But most important of all is its tonic effect upon the portions of the brain which are involved in the Olympian functions of reason and abstraction, judgment and intuition, comparison and deduction; in short, intellectuality. It has been asserted by certain anatomists that there are tiny canals leading directly from this gland to the great frontal lobes of the brain which are the seats of these very functions.

The posterior lobe or post-pituitary produces pituitrin, a substance which has been shown to be active in eliciting its effects in a concentration of one part in a hundred million of blood or water. It is the tonic of the cells of the organs, of the capillaries of the blood-vessels, of the smooth muscle of the organs in the chest and abdomen. People with a lowered tone of the abdominal organs, because of insufficient pituitrin in the system, suffer from a dropped stomach or dropped intestines or floating kidney or displaced uterus. But pituitrin is also of great importance for the tone of the emotional centers of the basal ganglia at the

base of the brain. And here the interesting fact appears that there is a tiny stalk, known as the infundibulum, which leads into the third ventricle of the brain, upon which these very emotional centers abut. It is believed by some that the pituitrin is passed directly into the third ventricle of the brain and thus plays a great part in emotional reactions. This is borne out by the observation that extracts made from these emotional centers contain a substance possessing the properties of pituitrin. Moreover, individuals in whom there is an instability of the post-pituitary are also emotionally unstable. And they are also sometimes curiously sensitized to the emotional element in their sensations, especially to rhythm and musical tones. So musicians are likely to be dominated by the post-pituitary in their make-up. With the overaction of the post-pituitary, there is often an excessive emotionalism and hypersensitivity, especially in women. Pituitrin also functions in the mobilization and burning of sugar, in the maintenance of a proper amount of sugar in the blood and tissues, and also in the handling of fats. Musicians are frequently stout.

With insufficient activity of both the pre-pituitary and post-pituitary there may be poor self-control and weak restraint of instinctive tenden-

cies at concealment, stealing, and lying. There is also a relation of pituitrin to skin pigmentation.

The pineal gland is a small organ, smaller even than the pituitary, and located above and behind it in the brain, covered over by the great hemispheres of the brain. It is placed in a region which ancestrally has been traced to the so-called third eye of certain reptiles and amphibian creatures. The microscope has revealed that pigment cells are present like those in the specifically light- and color-sensitive cells of the retina. These, however, are only a minority; the majority of the cells are definitely glandular cells, producing visible granules, which are probably its secretion. The pineal begins to be slowly destroyed between the fifth and seventh years of childhood, as there appears an accumulation of crystals of lime salts, sometimes forming large, easily perceptible masses designated by some earlier anatomists as brain sand. This is progressive throughout life.

Evidence collected hitherto and recently confirmed has indicated that the pineal has a particular function in childhood of restraining sexual and mental precocity. This anaphrodisiac effect possibly persists through maturity in some cyclic fashion. Indeed, feeding it has produced marked anaphrodisiac action in adults. The pineal may

also have an important influence on muscle development, tone, and chemistry.

The pineal, like the post-pituitary, may also determine pigmentation of the skin and so the reactions of the body-mind to light. Light and in particular the shorter waves of light, those at the ultra-violet end of the spectrum, are being demonstrated to be of greater and greater significance in the chemistry of life. It would seem that this influence of light, long recognized in plants but hitherto rather ignored in animals, may be mediated in the latter through the glands of internal secretion, particularly the post-pituitary, the pineal, and the adrenals. With these operations might be linked the fact that the pineal area was once sensitive to light. Also light and sex, and the pineal and sex, provide roads of approach for the consideration of the complicated relations of sex and environment.

Hindu philosophers, from ancient times, have taught that the pineal is the seat of the soul. Perhaps they were struck in performing autopsies, as they undoubtedly must have been, by the brain sand. In the seventeenth century Descartes popularized the idea among Europeans. It has been stated that certain Hindu sages have also proclaimed, in the prophetic ex-cathedra way, that

telepathic communication between human beings, the transference of thought (which is being investigated scientifically in our generation in relation to the suggestions of the radio), becomes more and more possible as the pineal becomes more dominant in the personality. It is an idea that perhaps would have intrigued Sir William Crookes, that curious genius with the always open, always responsive mind, who invented the Crookes tubes, the high vacuum tubes which were used by Lee De Forest for snaring wireless waves. But there is not the slightest shred of evidence for the conception.

The thyroid, placed conspicuously in the neck, has interested observers for centuries. The effects of its disturbances, so gross in both their physical and mental manifestations, concentrated attention upon it from the earliest times. For hundreds of years the Chinese have used preparations of animal thyroid gland in the treatment of cretinism, a form of idiocy due to the deficiency of the internal secretion of the thyroid gland. This treatment was rediscovered by the western world only a little more than thirty years ago. The moral is that our vaunted Nordic intellect needs to learn respect for the claims and assertions of the Oriental and especially the Mongo-

lian mind. The principle of experimental verification should not be limited by any boundary or color line. The European mind, indeed, for a time regarded the function of the thyroid as supremely to round out the beauty of a woman's neck.

As a shield-shaped organ draped about the Adam's-apple portion of the neck, the thyroid received renewed attention when the new technique of antiseptic surgery, introduced by Lister, stimulated certain surgeons in Switzerland to operate for goiter, the condition of thyroid enlargement with various life-endangering symptoms. It was found that complete removal of the thyroid produced a disastrous series of effects which stimulated research into their nature. A long series of researches and observations in the clinic and in the laboratory followed. One brilliant observation was that of Murray in England, who transformed the personality of a woman, to all appearances incurably degenerating both in mind and body, by first injecting and then feeding the thyroid. Though she was forty-two years old at the time and probably would have died in a few years, she lived to the age of seventy-four; that is, almost doubled her life span. During most of these years thyroid was administered, the glands

of 870 sheep being consumed. The work upon the thyroid culminated in the researches of Kendall, who succeeded in isolating what seems to be the pure active substance or internal secretion in a crystalline form containing a very high percentage of iodine, which he has named thyroxin.

For it seems to be the main function of the thyroid to handle the iodine which enters the body by way of iodine-containing foods, and, by combining the iodine with another chemical complex containing the significant chemical substance indol, to evolve a compound which regulates the level of energy production in the cells. Apparently thyroxin accomplishes this function by controlling the rate at which a certain fundamentally important chemical reaction goes on within the cells. This is for any individual a constant, known as the metabolic or combustion rate, an index of speed at which food material is being consumed to produce heat. As this reaction of heat production involves the basic chemical reaction of life in the higher animals, since they must above all necessities keep themselves warmer than their environment, the thyroid may be looked upon as the great controller of the speed of living. By its means the body-mind seems to have attained a device for shifting and lubricating the levels at

which energy is being evolved. Without enough of it, and also with too much of it, the body-mind loses its power of manipulating the gears to pass from first speed into second, and from second into third.

Great also is the influence of the thyroid during childhood upon the evolution of the body and mind which constitutes the chief concern of the child: to grow. Should the thyroid then function poorly or inadequately, the effect is, in extreme cases, a creature of horror, reminding one of an African idol. Stunted, gross, and yet puny; the eyes hidden behind swollen lids peering like an owl's; narrow-chested with bulging abdomen; the lower extremities rickety but covered with rolls of fat and loose skin—these are some of the details of the grotesque picture produced by lack of thyroid in a baby. A peculiarly coarse and repulsive aspect is given the expression by the large rolling tongue, which keeps the mouth open and drooping always. There is a mental deficiency or idiocy, and there may be deaf-mutism at the same time; the only words learned and articulated may be "ma" and "no."

This gargoyle of creative chemistry was once considered, as late as 1892, a hopeless idiot and defective, for whom nothing could be done. When

thyroid feeding was introduced to relieve the condition, the transformation wrought was the second great miracle of glandular chemistry, the first having been the remarkable effects upon himself produced two years before by Brown-Séquard, the great Franco-American experimental biologist, with the injection of sex-gland extracts. After thyroid is fed for a few months, growth is resumed at a remarkable rate, inches being gained in months; idiocy becomes intelligence and the caricature of humanity is converted into a comely or even beautiful child.

When trouble in the thyroid develops after childhood, then the emphasis of the condition seems to be placed not upon growth but upon the energy process of the body-mind. Shakspere had one of his characters say that every hour we rot and we rot and we rot. As a matter of fact we burn, burn, burn, not with a hard gem-like flame, as Walter Pater would have us, but with the subtle movements of molecules. Energy, that great unknown, which is responsible for all the motions and changes of the universe, including the courses of the stars as well as the goings-on in the tiniest of living things, is liberated faster or slower according as the thyroid overworks or underworks. The energy of life, according to the great law of

the conservation of energy, comes from the energy of food. But that energy may be liberated more quickly or more slowly, just as in any machine, by speeding or slowing the process which produces it. The thyroid regulates the energy producing process.

Normally the thyroid hastens energy production in times of fear and fight or flight, in emotional or sexual excitement, in fevers and infections, in various crises and emergencies of every-day life. When, however, the thyroid keeps up this process of energy overproduction we have the condition of hyper-thyroidism. There is then a curious lack of control of the emotions, an increased sensitivity to the stimuli of the outside environment as well as to the sensations from the internal organs of the body, including the heart, which runs away under the slightest excitement, or may beat too fast all the time, even during sleep. The eyes stare out upon an irritating world and seem sometimes to glare at the observer. There is a tendency to blushing and tremors, and the hands tremble easily. The individual feels hot, is very sensitive to heat, perspires freely, fears and complains of his nervousness. All this is because of an excessive production of thyroid secretion in the body-mind.

The reverse of the picture occurs when not enough thyroid secretion is supplied to the cells. The individual then takes on some of the characters of the cretin-idiot. The forehead, the eyelids, the cheeks, the backs of the hands, the nose, the fingers and toes become thickened so that they do not give when pressed. Hair once fine and silken may become coarse and brittle and then fall out completely. I once saw a woman who lost all of her hair in this manner so that her scalp was as smooth and flat as a billiard-ball. The temperature of the body falls, because not enough energy is being produced to compensate for heat lost by radiation. So these people complain bitterly of cold and cease to perspire, for perspiration is a means of losing heat, since its evaporation cools the skin. Mentally these sufferers may become dull and lazy, their memory for immediate tasks and affairs and occurrences being very poor; and so their intelligence, which lives upon memory, deteriorates. They need much sleep and suffer much from lack of it. They may have sleep compulsions, when they simply must fall asleep, no matter where they are or what they are doing. Expected to act and behave and be responsible, they often get into hot water and endure unjust punishment. All may be traced to degeneration

or destruction or injury of some sort of the thyroid; for by the feeding of thyroid substance, or by the injection of thyroxin, the same miracle may be wrought as in the cretin. The mental symptoms are generally the first to make their departure, the feeling of energy and vitality is restored, as indeed the whole *joie de vivre;* for the melancholia of the thyroid deficient is sometimes an appalling spectacle. The skin becomes soft and elastic, and the hair returns. There are, of course, various stages and degrees of the process, so that the symptoms and effects may appear only in miniature. But these so-called larval cases are most important for the recognition of what thyroid defects may mean to the personality, since they are most readily remedied by proper treatment. It has been noted in New York and London that after periods of general stress and strain, after financial flurries or epidemic disease threats, there is an increase of these slight thyroid insufficiencies.

Implanted within the body of the thyroid or placed directly behind it upon the windpipe, or at the sides of it, are four tiny glands, two on each side which, because of their proximity to their great colleague, are known as the parathyroids.

Partly because of their situation, but also because of their minute size, they were overlooked even by anatomists until 1880. And even then they were ignored and neglected by the physiologists for another ten years. Controversy raged as to whether they were entitled to consideration as individual glands, apart from the thyroid. It is now universally acknowledged that they are structural and functional entities, with an importance to the body-mind quite distinct from the thyroid.

In the pedigree of species they appear at the same time as the thyroid, emphasizing that there is some definite dependence of their functions. But they develop in wholly different sites, though they are neighbors. Yet it is easy to remove both thyroid and parathyroids together unconsciously because of their nearness. Confusing and contradictory results were thus obtained in experiments, which were not clarified until certain investigators succeeded in removing the thyroid without touching the parathyroids, or removing the parathyroids while the thyroid was left intact.

After separate removal of the parathyroids, the most prominent effect is a gross increase in the excitability of the nervous system. Such states of hyper-excitability may be produced by various

poisons, like strychnine for instance; but in the cases of parathyroid deprivation it is caused by lack of something. Life is a reaction to stimulation, but the amount of stimulation necessary to provoke the reaction varies greatly from individual to individual. Yet there is an average which may be regarded as the normal or standard. The excitability or irritability of the nerves of the parathyroid deficient individual may be increased, when measured by an electric device, by from 500 to 1000 per cent. Hence the ordinary stimulations of the environment, which do not affect other people or animals, will make him react, or throw him into a spasm or convulsions. Also, the reflexes, the inherited automatic muscle responses of the nerves, are more readily evoked. By directing light into the eyes, a series of twitchings may come, as a sort of overflow phenomenon, which remind one forcibly of the manifestations of epilepsy. So all the finely balanced equilibrium of the nervous system may be disturbed by a gland which weighs less than a grain.

The best provisional explanation for these occurrences is that which relates them to the history of lime in the blood and tissue. Lime, or lime salts, plays a most amazingly diverse and significant rôle in the manifestations of life. The late

Jacques Loeb, one of the great immortals of biology, was the first to insist upon that conception and to bring forward evidence for it. From functions as different as the construction and maintenance of healthy bone and teeth and the fluidity and coagulation of the blood, to functions like those of the chemical defenses against infection and disease, and of the nutrition and reactivity of the nervous system, it moves about in the organism with the concealed hand of a master. All the glands of internal secretion appear to influence and be influenced by its content in the body and tissues. But the supreme controller of its history and fate in the body seems to be the smallest of all of them, the parathyroids. For they determine how much lime salts, and particularly how much electrically charged lime, or, as the chemists class them, calcium ions, are to be retained in the body. For when the parathyroids become insufficient, when they have been removed, or injured, or strained, the body loses lime. More lime leaves through the excretory channels than goes in with the food, because the cells are unable to hold it. There results then a relative calcium starvation. Consequently, all the functions in which lime is involved suffer. The teeth fail to develop properly, especially as regards the en-

amel, because the lime is that which imparts the hardness and resistance to teeth and bones. Hence, small cavities form easily in the teeth in spite of the best dental care. The bones break readily, and fractures heal slowly and poorly. The hair ceases to grow or grows unhealthily; the nails become brittle and break quickly when subjected to slight pressures. Nutrition suffers, wasting sets in, and the end is death unless some compensatory process intervenes.

The condition of nerve excitability with parathyroid deficiency is known as tetany. In man it occurs more often in children, but it may also crop up in the pregnant, or after operations. But the most important forms of parathyroid deficiency are those which are latent, with none of the gross, well-known effects manifest. Such individuals are hypersensitive to all the different forms of physical and mental stimulation and may show symptoms varying from depression, nervousness, and restlessness to insomnia and inefficiency. The lack of steadiness of muscle and nerve makes them the prey of sudden crises and emergencies which they cannot meet successfully. A series of defeats inevitably breeds an inefficiency psychology which makes their life a purgatory. When combined with an over activity of the thyroid,

they are the sensitive-plants of human society, at the absolutely opposite pole from the vegetative forms of humanity whom we know as cretins and morons.

There is a type of mind which regards knowledge or enthusiasm about knowledge as the salvation of mankind with the manner of a duchess dowager in one of Ouida's novels inspecting John Galsworthy and saying, "You write, don't you?" The glands of internal secretion, as remarkable dominators of human personality, were first emphasized by practising physicians like Thomas Addison, who described the effects upon the body-mind of destructive disease of the adrenal glands in 1855. This report stimulated one of the most enthusiastic and fruitfully over-enthusiastic laboratory workers in the history of science, Brown-Séquard, to initiate and carry on a series of investigations involving the use of his brain and his imagination, mental work as well as the chemical instruments, assumptions, rules, and by-laws of the laboratory and laboratorians.

It was the outcome of thousands of observations made on individual patients, in the clinic and at the bedside by hundreds of practitioners of medicine that demonstrated the astounding influence of the endocrine glands upon health and personality, and

the subtle regulations and profound coördinations established among the glands. There are, however, some investigators who work in laboratories alone who wish all actual practitioners of medicine to deal with their patients as if they were in laboratories. Those unthinkingly swayed by them have objected to the heartening which must come to all public-spirited people with the realization of what the science of the internal secretions must mean for the future of mankind.

Science is not measurement alone, for if it were, every barometer would be a scientist. It is, indeed, any bit of knowledge coördinated with any other bit of knowledge. It is synthetic as well as analytic. It works with circumstantial evidence, with indirect indications, with the preponderance of proof, with inference and induction, as well as with direct demonstration. It incidentally also exposes the obvious buncombe and special pleading of commercial manufacturers who use the advertising methods and unscrupulous propaganda of their breed.

As long ago as 1906 an authoritative laboratory worker—indeed, an authority among authorities, Starling, the co-discoverer with Bayliss of the first hormone so named, secretin—wrote in his classic "The Chemical Coördination of the Body

Functions,'' ''If the mutual control of the body be largely determined by the production of definite chemical substances in the blood, the discovery of the nature of these substances must enable us to interpose at any desired place in these functions and by this means to acquire an absolute control over the working of the human body.'' If the proper amount of publicity and enthusiasm had been accorded Starling's prediction and prophecy, an infinitely greater amount of public support would have been given to research in the field of the internal secretions and many more much needed laboratory discoveries would have been made. If the proper understanding of these statements had been developed, there would have been a greater concentration of interest and provision for the possibilities of the clinic—every clinic, not solely the neurologic or the psychiatric —in working out the problems of human constitution and personality in relation to the glands of internal secretion. But why should it be necessary to quote eminent authorities when the supreme authority (theoretically but not actually recognized by every worshiper of the spirit of science) is the authority of experience, open to every one?

These considerations are a necessary prelimi-

nary to any statements about the thymus as a gland of internal secretion. It has been broadcasted, from certain authoritative quarters, that the thymus is not a gland of internal secretion, and hence that all views concerning its endocrine functions are bound to be erroneous. There is an overwhelming amount of evidence accumulated by the study of individual patients which, taken in conjunction with positive data of the laboratory, maintains the position of the thymus as a gland of internal secretion.

It is placed in the chest above the heart and the great blood-vessels emerging from the heart. Scattered through a network of cells in the interior are cell-whorls which stain characteristically with dyes. Of these there are many more in prenatal life than thereafter, except under pathologic conditions. They are known as the thymic or Hassal's corpuscles, and are believed to be the specific secretors of the glands of internal secretion. The thymus is present in all vertebrates, fish, amphibia, reptiles, birds, and mammals. This fact alone is enough to counterbalance any negative conclusions about its function deduced from the negative results of its removal in laboratory animals.

There is evidence for an antagonism between

the thymus and the sex-glands. The thymus is, therefore, one of the structures involved in keeping children childish, and may be spoken of as a gland of childhood in the sense in which the pineal may also be so described. Relative to the size of the body, the thymus is largest at birth and seems to decrease steadily and gradually in amount and influence until adolescence, when the sex-glands begin to dominate. As an effect of injury or disease the gland may increase in size, may indeed become from five to ten times as large as the average, and may then exert a profound modifying influence upon the temperament and fate of the individual. The signs of sex differentiation will be much less developed, with a tendency toward shifting of them in the direction of the opposite sex. There is a type of sex intermediate which seems to be related to an excessive function of the thymus.

An enlarged thymus may make trouble for the new-born baby and plague him from the moment of his entry into the world. The introduction of the new-comer to the first stranger he must encounter and get on good terms with, the oxygen of the air, may almost strangle him. Even after breathing has been established, it may be peculiarly noisy for days, become quiet for a time, and

then again paroxysmally become alarmingly unnatural, or accompanied by blueness and threatened extinction. The popular lay name for such an unfortunate is "blue baby." Occasionally an attack may come in a baby who apparently was born quite well and easily.

Besides the thymic corpuscles, the thymus contains numbers of cells which resemble the white cells of the blood known as lymphocytes. The thymic bodies are greatly affected by the general nutrition, and increase and decrease in number in various conditions. An enlarged thymus gland, containing an increased number of Hassel's bodies, has been found frequently in autopsies performed upon criminals. Evidence has accumulated that the thymus bears a relation to crime as it does to genius, and that the thymus must have some peculiar influence upon the blood and nervous system which predisposes to crime. That the Hassal bodies have a function is proved by the fact that they are being continually formed from before birth and into senility.

On the other hand, the lymphocytes in the thymus may play some important coöperative rôle in the formation of the secretion of the thymic corpuscles. Carrel has shown that lymphocytes are endowed with a function of primary importance

in the nutrition of tissues. He calls trephones the substances secreted by lymphocytes, which are nitrogenous nutritive compounds prompting growth of cells. Now, there exists a great deal of evidence that the thymus influences growth during childhood. It seems likely that special trephone formation all during life, the outcome of interaction between lymphocytes and Hassal corpuscles, is the particular function of the thymus. This conception is supported by the observation that during vitamine starvation the thymus suffers and atrophies. The vitamines may be the forerunners of the trephones as of other internal secretions.

Quite recently two new pieces of laboratory research have been reported which confirmed the endocrine view of thymus function. Riddle has shown that after the removal of the thymus in fowls they will lay eggs without shells or with very thin paper-like shells. This revives the older conceptions of a relation of the thymus to the history of calcium in the body, since egg-shells are almost pure calcium carbonate. Roussy has reported that the atrophy of the genital organs which follows the removal of the pituitary gland can be cured by feeding thymus gland.

Over each kidney, sitting on it as a cocked hat

sits on a head, is an adrenal gland. Each adrenal gland is composed of two parts or layers which are really distinct and individual glands in themselves. The outer gland is known as the cortex, and the inner as the medulla. To distinguish the two some people speak of the outer as the interrenal gland and the inner as the suprarenal gland. The secretion of the outer portion has not yet been obtained in the pure form or even as an extract with constant properties. The function of the inner portion is to secrete one of the best known of the internal secretions, the substance known as adrenalin.

The adrenal cortex has a relation to the control of metabolism, to sexuality, and to the nervous system. It counteracts the effects of the thyroid upon metabolism. For while the thyroid speeds up the production of energy and the combustion of food, the adrenal cortex slows the process so that, while the thyroid drives, the adrenal cortex checks the fundamental chemical reactions of life. The effect of the adrenal cortex upon sexuality varies in the life-history of the individual. In the embryo it is germinated from the same area that evolves the sex-glands, the germinal epithelium. Always the effect of its secretion is to increase masculinity and to oppose and neutralize femi-

inity. Before birth, when the sex of the child is still more or less plastic, the consequent result of adrenal cortex overaction is to produce a condition of seeming bisexuality, or pseudo-hermaphroditism. A female, then, who manages to be born and survive the risks of childhood will grow up presenting the characters, not only of a female, but also those of a male in a more or less well developed form. She may pass for a man all her life, be married to a woman, and not have her condition discovered until after death. A number of such cases have been reported in which the post-mortem findings have been the coexistence of ovaries and tumorous enlargements of the adrenal cortex.

If such enlargement begins suddenly or gradually in a child, apparently normal previously, sexual precocity with all its accompaniments follows. A child under five may thus grow in a short time to resemble a girl of twelve or thirteen. But certain of the features of the true femininization of puberty are lacking. In a boy, however, the picture evolved by such adrenal cortex overaction is that of a strong, hairy dwarf, sexually mature but intellectually immature. The muscular strength of some of these children is so great that the type has been called the "infant Hercules." Adrenal

cortex overaction in a sexually and bodily mature woman will cause a sexual reconstruction of her personality. Hair will grow upon her body as upon the face, sometimes elaborating quite a respectable mustache and beard; the muscles will increase in size and strength and power; and the voice will acquire the masculine basso quality. Psychically there is also a very great change. The woman becomes dominating and aggressive in her general attitude, a tendency to violence and pugnacity is exhibited, and in sexual relationship she tends to take an active rôle which may attain the proportions of true homosexuality. As virility is the outstanding concomitant of this condition, it is designated as virilism.

The adrenal cortex contains more of the peculiar fat-like substances or lipin substances known as the lecithins and cholesterols, which are also present in the nervous system and have much to do with its functions, than any other organ. And there can be no doubt that the development of the brain and the development of the adrenal cortex are somehow correlated. But, in addition, the adrenal cortex has a relation to skin color or pigmentation. It lessens the sensitivity of the skin to light-rays, and so it tends to restrain the deposition of pigment in the skin. When the cortex

is destroyed by degenerative disease the color of the skin darkens.

Adrenalin, the internal secretion of the adrenal medulla, is much the better known. For a long time, indeed, the cortex was ignored, and adrenalin was the only known secretion of the adrenal glands. It is present in the blood in the concentration of about one part in twenty million, while there are about a hundred thousand times as much in the gland itself under normal conditions, doubtless as reserve. This reserve is easily and often tapped for the dynamic purposes of the individual. It is the energizing principle of the organism when exposed to situations of stress and strain. Cold, pain, excitement, as well as exercise, infections, and intoxications, evoke an increased discharge of adrenalin into the blood. When its content in the blood, the tissues, and the nerve-endings is thus increased, there is a rearrangement of affairs for the time being which can be best named as *energizing*. More sugar is delivered to the blood from the warehouses of the liver; more red blood-cells are mobilized from their billets in the spleen and bone-marrow; and all the tissues as well as the brain-cells become more alert, more alive to stimulation and sensation. The eyes see more because the pupils di-

late, the ears hear more, breathing is deepened, the heart is more rapid. Resistance to pain also increases. Its peculiar tonic effect upon the heart has been demonstrated in certain babies who seemed to die in a few minutes after being born. Injection into the heart has, in some cases, brought them back to the living—a true example of chemical resurrection. Adrenalin seems, indeed, to be the body-mind's own tonic for emergencies.

Before and after a recent marathon race Devine and his collaborators studied the sugar content of the blood of various entrants. The run covered about twenty-seven miles. The winner, who was about forty-seven years old, had at the end of the race about the same amount of sugar in his blood as he had at the beginning; that is, the content was approximately normal. Three men who were beaten by him, and had about a normal sugar content when they started, showed a decrease to about one half. Obviously the winner possessed a mechanism for the regulation of the sugar content of his blood superior to that of his competitors. Obviously the possession of such a mechanism must have had a great deal to do with the conditions of his success. For in exertion or exercise the sugar of the blood is burned

CATHERINE CORNARO, BY TITIAN

Showing facial characteristics of a feminine thyroid-centered type

to supply energy. It, therefore, tends to become lower and lower, with a corresponding drop of the individual's muscular capacity and energy. More adrenalin secreted into the blood would then tend to force more sugar into the blood and to raise it to the best functioning level. The winner, then, apparently possessed a better glandular mechanism for keeping his blood sugar normal than his rivals had. The adrenalin reserve undoubtedly had much to do with this mechanism.

There is an internal secretion which does the converse of what adrenalin does to the sugar content of the blood. This is insulin, the internal secretion of the pancreas or liver sweetbreads. While adrenalin increases the sugar content of the blood, insulin lowers it. Banting and Best recently isolated the substance in solution from the gland for use in the disease diabetes.

The pancreas has both an external and an internal secretion. The external secretion, which the bulk of the cells of the glands are occupied in manufacturing, is sent into the small intestine to mix with the bile and consummate the major work of digestion of the food delivered from the stomach. Other cells present in the pancreas, in collections like islands distributed here and there among the digestive-juice-producing cells, elabo-

rate the substance, which is absorbed by the adjoining blood-vessels and then transported to all the cells of the body upon which insulin acts. Insulin acts particularly to increase the ability of liver and muscle cells to take from the blood the sugar which is easily soluble in water and blood and then to turn it into a form of sugar that is like starch, which is not soluble in water and blood and so can be stored for future needs. Adrenalin acts to reverse the process, to facilitate the transformation of this starch-like sugar, known as glycogen, into an easily soluble and diffusible sugar known as glucose or fruit-sugar. Pituitrin, the internal secretion of the post-pituitary gland, also increases the mobilization of sugar. Thus in the maintenance of an adequate sugar supply to the cells, which means the maintenance of an adequate energy supply to them, there is a delicate balancing of the counteracting effects of adrenalin, pituitrin, and insulin. The other internal secretions probably also play a part. In the disease diabetes the mechanism is disturbed because of an insufficient amount of insulin in the blood. The blood sugar is then too high, because the cells cannot use the sugar that is supplied to them in excess by the liver which cannot store it. Like a starving man surrounded by gold, the cells

suffer because they cannot utilize the sugar with which they are surfeited. Diabetes may occur as a break in the adrenal-pancreas equilibrium, either on the adrenal side, promoted by a life which produces adrenal overactivity, like intense and repeated worry and apprehension, or on the side of the pancreas by straining it through overeating, particularly the overeating of sugar and sugar-producing foods. But there are a number of other conditions, sometimes approaching the dignity of disease, in which there is some upsetting of the glandular regulation of the sugar supply, so that the blood sugar is too high or too low. Such individuals are nearly always underweight or overweight. They are handicapped in the struggle for existence and may be compared to an automobile running on an insufficient number of cylinders, and so unable to make the grade upon demand, or always running in high speed with disastrous consequences for the machine.

The gray matter of the brain, and the glands of internal secretion, the pituitaries, the pineal, the thymus, the thyroid and parathyroids, the liver and pancreas, the adrenals and the sex-glands, constitute the core of the personality, because they are the mediators between the individual and the environment. There is nothing in an environ-

ment to which they are not sensitive and responsive. To the iodine content of the environment, to the lime and phosphorus content, to the content of iron and potassium, to the protein, fat, sugar, and starch content of the food, to the content of cold and heat and light, moisture and dryness, to the physicochemical content and conditions, the glands of internal secretion are most sensitive and responsive. To the psychic content, the content of materials providing sensations and emotions and needs, the gray matter of the nervous system is sensitive and responsive. And the two systems, the nervous system and the endocrine system, interact to preserve the individual against the environment and to further his purposes in it. The composition of the core of the personality, the quality and quantity of the gray matter as well of each of the glands of internal secretion, is primarily determined by the chromosomes of the fertilized germ-cells, but secondarily and just as importantly influenced by the history of the individual from the moment of fertilization—the episodes, adventures, accidents, and sequences of the biography of the material of which he is made. In other words, it becomes susceptible of quantitative analysis in the degree to which we become able to analyze the amount of gray matter present,

and the amounts of the various internal secretions acting upon it. The actual personality built of experiences, habits, and instincts, as well as the historic residuum conveniently designated the subconscious, grows out and envelops and yet expresses the core.

CHAPTER V

THE GLANDS IN CHILDHOOD

IF children are the stuff of the future, then we should all be interested in whatever provides information concerning the material of which they are made. The science of stuffs or materials is the science of chemistry. What can chemistry, particularly that branch of chemistry which concerns itself with the composition and construction of living things, tell us about children?

For it is important for us to understand children if we are to understand adults. Saying that the child is the father of the man is a way of emphasizing the fact that the child grows into the man. If we are to get any insight into the problems of personality, we must remember that outstanding fact all the time. Besides, children in themselves present the most fascinating problems of the personality, its growth, development, and disturbances. Moreover, as children are grow-

ing, they are relatively malleable and mutable. They may be changed for the better or the worse much more easily than the grown-up. By various procedures one may hope to influence them in the most far-reaching way.

Let it be made clear at once that the modern student of children has discarded the prejudices and superstitions of the past concerning the existence of a body or of a soul. For him mind and flesh do not function as separate, distinct, and necessarily hostile entities. He denies that it is compatible with truth to regard them separately at all, and the ideas thus created he considers rather futile and harmful abstractions. Upon the body and mind of the infant, of the runabout, of the school-child, of the adolescent and the post-adolescent who has not yet finished growing, he looks as the products of interacting chemical substances, forces, and energies.

He does not deny that individual problems of conduct may not be approached directly from the point of view of suggestion, habit-formation, and training. Yet he is keenly conscious that such an approach, however useful in particular cases and problems, is totally inadequate for an understanding of the fundamental nature and functioning of the personality. It is, indeed, as inadequate as

would be the manœuvers of a telephone operator, who knows that by inserting various plugs in differents parts of a switchboard she can obtain various connections and can start conversations, for one who is seeking to understand, let us say, the workings of a dynamo.

Researches of chemists extending over the last hundred years or so have demonstrated two very important facts: first, that all living things have practically the same chemical composition; and, second, that the composition of animals, including human beings, is essentially that of the food they eat. Public education has made people more or less familiar with the classes of chemical substances of which foods are composed. Moreover, recent laboratory studies, with certain additions, have, by and large, conformed and completed these teachings.

Nearly every woman who gossips at a mah-jongg party can tell you with much satisfaction that she is living upon a particular diet of proteins, carbohydrates (starches), fats, salts, vitamines, and water. If, as is usually the case, she fancies herself on calories, she will provide you with the details of a completely balanced ration in five minutes. These constituents of our food do indeed compose the warp and woof of our

being. We are such things as our foods are made of.

Children's physique and disposition have long been recognized to be greatly dependent upon their feeding. Every experienced nurse, like every experienced mother, is aware of this law. From the day of the baby's birth, when its evolution is started by a dose of breast-milk, to the day of its first attack of colic because the mother has partaken of too much candy or some other indigestible food, its parents are taught how quickly its body and soul will react to changes in its dietary. If the baby is kept on breast-milk too long, and consequently suffers from iron starvation because there is relatively too little iron in breast-milk, one has the spectacle of a puny, retarded, dull, pale, anemic infant which has ceased growing physically and mentally. If, now, it is treated with iron in the proper doses one may see in a week the seemingly miraculous change of a resumption of onward development of body and soul. No one who has seen these and other startling mutations for better or worse, according as a milk formula is changed, or proper hygenic conditions, like sufficient sunlight, enforced, or the necessary chemical compounds administered, can fail to be convinced of the utter dependence of the

child upon the materials out of which it has to manufacture itself.

In short, to the chemist the child is just a chemical mixture. That is to say, it is a mixture of various chemical substances arranged, to be sure, in an orderly manner as its cells, which must be continually replenished from the outside by similar substances in food. The reason for the replenishment is the fact that a continual destruction of the cells goes on with every breath we take. In the language of the chemist, we oxidize or burn them. The whole process of destruction and replenishment goes by the rather mysterious name of "metabolism." The primary principle to be emphasized, therefore, is that every baby, like every child, like every individual, is a chemical mixture undergoing metabolism. Its body and its mind, its temperament and its character, are by-products of this process.

Now the question arises: What causes the different food-stuffs to interact in different parts of the body, including the brain? What is at the core of the machines we are acquainted with as functioning organs? In the first place, the food elements are broken down in the stomach and intestines into the simplest units. These are then readily absorbed and transported by the blood,

democratically, with no favors shown, to all the cells. The carbohydrates, or starches, are broken down into simple sugars. The fats are disrupted into glycerin and the fatty acids. The proteins ("protein" is the class name for nitrogen-containing substances that are chemically like white of egg) are split up into their constituent amino-acids. The salts, including compounds of lime and phosphorus, potash and soda, and the Vitamines, A, B, C, D, and E, pass directly into the blood. Last but not least, there is water. Water is the great solvent and the medium for chemical reactions.

Consequently, food, and particularly the feeding of children, takes on a new and overwhelming importance. It is not to be compared simply to the stoking up of a machine. That is still one of the extant and universally distributed popular misconceptions which have led to much self-inflicted harm by those who have played with a little knowledge. Food is *not* like coal in a furnace or tobacco in a pipe. It is the very material out of which the human machine makes and remakes itself day and night. In childhood it is the stuff which is designed into the most marvelous varieties of cell patterns, and it sets going the most intricate phases of transformation, like

the making of teeth, hair, blood and flesh, brain tissue and nerve filament, until at last the seven-pound chunk of helplessness stands evolved, a man, ready to face and conquer life.

No one, therefore, can exaggerate the significance of nutrition. It is idle to speak scornfully of materialism, to sigh yearningly for idealism or spiritualism. *The chemistry of the cell is the chemistry of the soul.* Nor do we mean by nutrition simply the mass the individual or child has acquired or is carrying about with him, although there can be no doubt that a good many people are suffering from an overload of nourishment, which they must transport or park wherever they go as excess baggage. Among such cases one must distinguish malnutrition from subnutrition. It is possible for one to have the appearance of being exceedingly well nourished who is nevertheless a victim of malnutrition, or bad feeding; that is, feeding upon the wrong kinds and proportions of foods. Similarly as it is possible for one who looks poorly nourished to be dieted quite properly as to kinds and proportions of foods but to be burning them up at a rate higher than the average, because of lack of rest, exceptional vitality, excessive action of the thyroid gland, or insufficient support by the adrenal and other glands.

Good nutrition does not mean mass, or volume, or the relation of height to weight, or color, or appearance. It is a much more subtle matter than that. It means the intake and the right handling daily, three times in twenty-four hours, of the right combination of water, the seventeen amino-acids, sugar, the salts (containing minute but significant amounts of iodine and arsenic and silicon and zinc), and the vitamines, properly prepared for the teeth and the appetite, digestion and assimilation. It means particularly in the child the adjustment of demand and supply in a being undergoing a slow, gradual, and amazing metamorphosis of its building-stones.

Hence, the modern investigator of the personality of children, of personality disturbances, deviations, distortions, looks first to see whether they are suffering from chemical starvation, and from starvation not in the sense of utter deprivation, but the less obvious starvations that appear only upon the careful, correct analysis of foods. Iron starvation, iodine starvation, lime starvation, specific amino-acid starvation (it has been shown that the amino-acids lysin and tryptophan are absolutely necessary for growth), or vitamine starvation, may all be responsible for retardations or perversions of de-

velopment. It follows that the diet of a child should no more be left to chance or instinctive choices than its education. Neither should sunlight, exercise or play, and rest, be neglected, for sunlight influences the assimilation of lime, exercise affects the burning of sugar, and rest may determine a balance of general replenishment over destruction.

Granting now that the correct quality and quantity of building-stones have entered the blood, the conditions outlined above having all been fulfilled, what happens to them next? Some are taken up by all the cells for their immediate needs. Some, like sugar, are stored in the liver and muscles. And some, like fat, are deposited in various localities, as about the hips and abdomen, because sugar and fat are the favorite energy reserve materials of the body. Some are selected by special tissues for special purposes; thus, iodine is picked out by the cells of the thyroid gland to be elaborated into its internal secretion called thyroxin. Which brings us again to those most important regulators of the chemistry of cells, the glands of internal secretion, and their influence upon the personality of children.

The glands of internal secretion, the thyroid and parathyroid in the neck, the pituitary and

pineal in the head, the thymus in the chest, the adrenals and gonads or sex-glands in the abdomen, are chemical specialists. They are chemical engineering plants which have specialized in the production of valuable substances for the community of cells, comparable to steel factories or soap factories in the communities of human beings. These glandularly produced substances are familiar as the hormones. How immensely important they are may be realized from the statement that *they cause things to happen to and between food-stuffs.* Without them the food-stuffs would remain just a dead mixture, with very little change over long periods of time. With them the entire complicated series of reactions occurs between food-stuffs in the orderly way characteristic of life. The regulator of a clock controls the speed at which it goes. Similarly the glands of internal secretion are the regulators of the chemistry of all our cells. Including the brain-cells, they thus come to be the regulators of the chemistry of our souls; our children, therefore, are utterly at their mercy.

All the chemical reactions in the body, including those at the basis of anger, joy and fear, intelligence, character and will, occur between the elementary food constituents after they have entered

the blood and become accessible to the cells. The nature, number, and course of these chemical events are most complex. But they must all proceed in a certain sequence, in a particular ratio, and at a definite speed, before we may have normal health and activity. The quantities of the different food elements taking part must be harmonized, much as the gasolene and air mixture in an automobile must be in the right proportion for a satisfactory sort of explosion. Also there must be the proper sort of ignition spark. Instead of one mixture the body contains a great many mixtures, all of them important and all part of the great process of life. And so instead of the simple and gross mechanical regulation of the automobile, there function the more subtle and finer chemical regulations by the glands.

Whatever else children are, they are chemical machines of the highest complexity. The internal secretions, products of the glands, are the mainsprings of the mechanism for several reasons. They control the mobilization of the food reserves from the internal warehouses, both for routine needs and for emergencies. They direct the course of the processes which supply energy, stimulation, or depression. They determine the fate, the history and adventures of the food par-

ticles that the diet of the individual has furnished. They remove poisons formed en route, prevent their accumulation, hasten their elimination. They influence the first and second and third lines of chemical defense by which the organism protects itself against its most formidable enemies, the ubiquitous germs of disease and decay. Can we exaggerate their importance?

With the certainty then, of the dominance of the endocrine glands over the well-being of the child, there is immense justification for the most intense interest in their functioning. What controls their well-being? Since they are tissues, like the other organs of the body, they are directly dependent upon the food intake for good health. Indeed, that they are no exception to the general rule is proved up to the hilt by much accumulating evidence.

There is every reason to believe that the food provides the *chemical skeletons* out of which the glands elaborate their secretions. Thus adrenalin, the secretion of the adrenal glands, must be a derivative of an amino-acid. And thyroxin, the product of the thyroid gland, is a combination of iodine and a modification of another amino-acid.

Then there are those dominating little things of nutrition, the vitamines. They undoubtedly play

a great rôle in glandular metabolism. The public has been made familiar with their enormous influence upon growth, development, and nourishment. There is ample room for the assumption that these influences are effected through the glands of internal secretion. It has been shown that the thyroid, thymus, and gonads atrophy on a diet devoid of vitamines. Growth will not follow when thyroid is fed to animals on such a diet. On the other hand, feeding thymus will act as a substitute for Vitamines A and B. The thymus, in fact, has been called the pivotal organ of vitamine metabolism. The adrenal glands attempt to compensate often for vitamine deficiency in the diet.

Excesses, like deficiencies of the food elements, may have a potent injurious effect upon the glands, and so upon the running of the body and mind. Excess of sugar and starches may strain the pancreas. Excess of proteins may cause the thyroid to oversecrete; excess of fats may cause it to undersecrete. It is conceivable, too, that excess of lime may hurt the parathyroid glands. All these facts emphasize again and again the importance of the food elements acting directly upon all the body cells and indirectly through the glands of internal secretion.

Food, however, is by no means the whole story. It plays a major rôle only when the inborn glandular equipment of the child is relatively adequate, and so normal, for its needs, and remains so in spite of the attacks of disease and other injurious agencies. So first of all we must consider heredity. The child inherits its glands from its parents and ancestors just as it does its other physical, mental, and moral characteristics.

Like food, heredity is a matter of chemistry. There has always been an atmosphere of mystery about the discussion of its problems. Even today "heredity" is popularly used as a sort of mystic term with which one waves away the unknowable and the uncontrollable. Slowly we are learning and shall continue to learn more and more of the relation of heredity to the glands regulating personality.

It is worth while in this connection to sketch in the most general outlines our present knowledge of heredity in relation to the glands.

Blood will tell. In these three little words, and their equivalent in every language, popular opinion has crystallized its conviction of a chemical continuity between the parent and the offspring. Modern biology has confirmed and extended this

opinion in a number of ways; it talks about the continuity of the germ-plasm, which means that there is the same material in the reproductive cells handed on from one generation to another in any family.

Logically the word "offspring" itself implies the same idea, that the descendant is a piece of the ancestor that has sprung off or broken off or separated off. It has often been found that the prehistoric creators of words put into them meanings that the most recent science has not been able to better. When we take a piece of chalk and break it in two we expect, and indeed cannot otherwise conceive, but that each piece has the same properties as the original one except for a difference in size. The conception of a chemical sameness of parent and child is but a corollary and extension of this relation. The child is a piece of the parent that has broken off and gone its own way.

In the higher animals and human child, though, the conception is complicated by the fact that there are two distinct chemical contributions to the incipient body, that of the mother and that of the father. At once many questions suggest themselves concerning the result, which resembles

either the father or the mother, or has qualities of both, or of one or the other's ancestors. What part do those always involved glands of internal secretion play in the process?

Every person begins as a minute droplet of that peculiar, mysterious, wonderful jelly known as a protoplasm. So tiny is the globule of living matter out of which our Person Unknown has made himself that it is beyond the range of the eye unaided by instruments like the microscope. Into an area of one square inch some four hundred drops like it could easily be crowded.

The precise point at which the individual begins may be defined as the point in time at which one such drop of protoplasm, derived from the mother, and called ovum, is penetrated by another but differently shaped bit of life-stuff derived from the father, and known as the sperm-cell or spermatozoön. With their fusion starts a process of increased chemical activity that takes a number of different directions and leads to all the marvelous unfoldings and heaping up of tissues and organs, of growth and development. It flowers in the mature specimen of the species and can terminate only in death. No human achievement of the highest genius can compare in com-

plexity or subtlety, profundity of intelligence, or inexorable quality of onward march of the will, with this process and its product.

It follows, then, that the fundamental factors involved in this series of chemical events by which the germ-plasm becomes the individual must be of the most attention-gripping interest. They are indeed. Tiny particles, they bear a name that should become a part of the vocabulary of everybody, the "chromosomes." They are so called because they become deeply colored and easily recognized when subjected to the action of certain dyes.

Until recently it was believed that the chromosomes were the only chemical substances concerned in heredity. An Italian, Golgi, demonstrated the existence in cells of a peculiar constituent which had never been described before, and which was named in his honor the Golgi apparatus. Dr. Perroncito, a pupil of Golgi, was the first to study the behavior of this apparatus in the reproductive cells. He showed that in addition to the chromosomes there must now be taken into consideration in heredity a number of short, bent threads into which the Golgi apparatus breaks up, which he calls the diktosomes. The moral is that no one can speak of any piece of work in sci-

ence as complete, or finished beyond compare or repair. For a new method or new viewpoint may completely overturn the most fixed positions. Einstein has done that for physics. And the history of science is full of similar instances. All the sanctimonious self-righteous who pat themselves on the back because they have never committed themselves to the truth of any proposition for which there was no absolute proof, or because they accept only that which is preached by high authority, are to be classed as the Pharisees of science.

Chromosomes and diktosomes are the chemical carriers of those qualities of mind and body, physique and soul, which are handed on from parent to child. Certain observations suggested that they were the essence of the family tree. That they are the tree-sap of genealogy was demonstrated by the researches of Morgan of Columbia University, and his collaborators.

There is a little fly, the fruit-fly, which bears the technical designation *Drosophila,* and of which we have already spoken. It will breed anywhere in myriads. Walls and ceilings may be festooned with fruit-flies in a short time. They may be cultivated in tubes and bottles, and pedigreed individuals may be followed over dozens of gen-

erations, as they reproduce every ten to fourteen days.

Morgan's observations upon the fruit-fly have made it clear that chromosomes are compounded of a number of units which he calls genes or factors. These are like the tiniest of beads strung in a row, the whole constituting the chromosome. Each of these factors is probably a distinct and different chemical individual. At any rate, each one determines something to be developed in the adult and mother creature. One has been shown to influence the shape of the wings of the fruit-fly. Another has been shown to control the color of its eyes; a third, its total size; a fourth, its fertility; and so on, embracing every analyzable character. Each chromosome may have hundreds or even thousands of these genes. To be well-born means to have the right number and quality of genes. "Look out or heredity will get you, body and soul," says the flapper in Israel Zangwill's play, "We Moderns." Look out or the chromosome genes will get you, says the biologist.

The chemical secrets of the chromosomes and their genes are for the present completely locked from us. A great deal has been learned concerning them, but no one has as yet attained the ideal of establishing a correlation between a given

THE WOMAN WITH THE HORN

A piece of sculpture from the caves of Dordogne, between twenty and thirty thousand years old, showing the characteristic distribution of fat in pituitary gland deficiency

character, say the color of the eyes, and the chemical constitution of the gene responsible for it. Nevertheless, all our knowledge about things and their properties entitles us to the assumption of the existence of such a correlation. Its establishment is a matter of time and further development.

Our child is, therefore, a United States of chromosomes, genes, and their energies. It is their interaction when ovum meets spermatozoön that constitutes a first chapter in any biography. Charles Dickens begins the story of the life and adventures of David Copperfield with a pathetic picture of David's birth in a workhouse. It was left to the genius of biology to see his true beginnings and detail the picturesque preliminaries by which the chromosomes became the baby.

Ovum meets spermatozoön. Chromosome meets chromosome. Genes meet genes. There is unloosed a tremendous but orderly sequence of energy explosions, of additions and subtractions and rearrangements of matter, that finally culminate in a Shakspere, a Napoleon, or a Darwin. Quietly, inscrutably, with the silent decorum of an aristocrat of aristocrats performing a function which is routine but necessary, the fertilized ovum absorbs its nutriment from the mother's blood and unfolds its marvels. It grows big with sub-

stance, divides and subdivides. The one cell becomes the many cells. The microscopic becomes the macroscopic. At last we can see something with the naked eye, a minute ball which suggests a miniature mulberry and so has been named the morula.

The morula decides that it wants a mouth with which to eat the world, for that is its objective. So a hole appears upon the surface of the tiny mulberry, which enlarges and increases until it looks like a cup. The inside of the cup is called the entoderm, and the outside is called the ectoderm. By contributions from the inside and the outside a third layer is formed between them which is called the mesoderm. These are the famous three germ-layers which now begin to form the recognizable outlines of organs and tissues. Thus the ectoderm becomes the central nervous system, and the skin and its appendages, the hair, teeth, and nails. From the middle sheet of cells, the mesoderm, the muscles and bones are evolved by the organ-forming substances. And the entoderm makes itself into stomach and intestines, and into organs like the liver and spleen. Many different kinds of structures, consisting of many different kinds of cells, arise as little specializing spots and streaks scattered here and there in the

general uniformity of the herd, until the whole human being is produced.

Among these specks and suggestions of the future organs appear the originals of the glands of internal secretion. And they come to play a curious rôle, quite unlike that of skin or muscles or bone. They appear in a certain order which, perhaps, indicates the relative dates of their influence upon the developing body. For we possess evidence that, not satisfied with merely being evolved and contentedly taking their place in the scheme of things, quite pleased with their station in life, they set out to influence and affect the course of development of the rest of the organism.

Absolute evidence we have of this principle for the sex-glands only. Cows frequently have twins. And when these twins possess a circulation in common in the womb there may be born a male and a female, but the female has certain sex characteristics which cause the farmer to call it a freemartin. The freemartin is recognizably female but remains sterile and presents upon close examination sex characteristics which are an approximation to those of the male in certain directions. In other words, it is not really a female, but represents an intermediate sex, standing somewhere between the complete male and the

complete female. It has been shown by Lillie that this is due to the fact that in the male the sex-glands appear earlier than in the female, that they must then produce their secretion earlier than the female, and that they thus twist the sexuality of the female into their own male direction of development by getting into the inside track, so to speak. These views have been confirmed experimentally by Minoura, who grafted bits of sex-glands of chickens into incubating eggs and obtained all the intermediate stages between male and female. We know, then, that even, when the Newton or Roosevelt-to-be is only three weeks old and about one tenth of an inch in size, and when to the naked eye he is just a shapeless drop of sticky stuff resembling boiled starch, the sex-glands have attained existence and are manufacturing their secretion.

The other glands of internal secretion, too, make an early appearance. The thyroid is recognizable as early as the first week, when the embryo is about one twentieth of an inch long. And the pituitary can be identified in the second week, when the clever bit of slime, as Samuel Butler called it, has doubled its size. By the fourth week, when it has reached the respectable size of a quarter of an inch, thymus and parathyroids can be

identified. Each, because of its influence upon metabolism, must influence the course of development.

So we see enacted a spectacle that a novelist would recognize as similar to his own experience. The novelist sets out to create a character. But the character, if he is a real character with a distinctive individuality of his own, does a queer thing. He rebels against his creator and refuses to behave simply as a puppet or a marionette. He begins to react, to influence the other characters, to distract the course of the plot or of the story. Willy-nilly, the novelist must write of the adventures of his character, as if he were a real person outside himself, outside his brain, in the multitudinously complex world. The created turns upon the creator, like Prometheus upon the gods. A new turn, a whole series of new turns, is given to the story, quite beyond the original intention of the author.

The energy of the organ-forming substances in the chromosomes begets the glands. And then the glands seem to take matters into their own hands, as it were, and determine the begetting of what comes after them. By their chemical influence upon the rate of growth and differentiation and function of different tissues and organs, in-

cluding the nervous system, they appear again as arbiters of the destiny of the individual even before he is born.

It may be said that the amount of influence each gland is to have lies dormant in the chromosomes. Thus the chromosomes again must be looked upon as the ultimate controllers. But that is only a half-truth.

For it must always be remembered that the glands of internal secretion are the individual's chemical means of reacting to and adapting himself to the environment. Even in the mother's womb he is subjected to the action of an environment, the mother's blood, bathing him night and day until he is born. Essentially that blood will influence him because of its chemical constituents. And among the constituents are the products of the glands of internal secretion of *the mother*. To these the gland of the developing individual can and must react. Thus it has been shown that changes in the thyroid and parathyroid of the mother will produce visible or determinable changes in the thyroid of her offspring after birth.

In other words, there is a constant interchange of substance between mother and embryo. The glands of internal secretion are most sensitive to

this interchange. So the nutrition or disease of the glands of the mother may have a most profound influence upon the fate of the child. A lack of sufficient iodine in the mother's diet may hurt the child's thyroid gland and hence the entire course of its development, arresting or stunting or distorting it, or weakening its power against future emergencies. A lack of sufficient lime may affect the child's parathyroid glands, and so the irritability of its nervous system, which they regulate. All along the line the relation between the glands of the mother and the glands of the embryo may cause definite and even profound deviations, for better or for worse, from the plan of development latent in the chromosomes.

It follows that from the standpoint of prevention of disease and disability, supervision of the mother's diet, and correction of any glandular defects or disturbances, are indicated. They are indicated, too, for the sake of the mother, the drain upon her nervous system, and the dangers and difficulties to which she is constantly exposed. And they hold out hope for the perfection of our capacity to influence every mother for the best interest of the child, and by so bettering the quantity and quality of the materials entering into its

development to produce ultimately a superior kind of human being.

After birth the child continues a developing, growing individual. From both the biological and social viewpoints, that sums up its business in life—to grow and to develop. Now, the growth and development of organisms as low in the scale of evolution as the frog have been demonstrated to be controlled and indeed initiated by one or more of the glands of internal secretion. Thus the change from the tadpole to the frog, a most interesting metamorphosis, is preceded by a specific change in the thyroid gland of the tadpole, a change signifying active production of secretin. Metamorphosis will not take place if the thyroid is removed, but it may be produced thereafter by the feeding of thyroid. Frogs of the size of flies may be created by feeding thyroid to very young tadpoles.

We have evidence of the importance of the thyroid gland in the similar metamorphoses of the human being. For it is not sufficiently recognized, or not recognized at all, that the human infant undergoes metamorphoses like the tadpole. They are, it is true, not so spectacular, but they are just as important.

Three metamorphoses, in fact, occur in child-

hood, corresponding to three different periods of differences in growth rate and in the character of the growth.

For convenience, the most distinctive occurrence of the first metamorphosis may be considered the eruption of the temporary or milk teeth.

The outstanding feature of the second metamorphosis is the shedding of the first teeth and the sprouting of the permanent set.

The third is the metamorphosis of adolescence and is characterized by the prominence of the emerging sexuality of the individual.

These three periods of metamorphosis are of the greatest importance for the understanding and behavior of the so-called normal child, as well as the abnormal and the subnormal. The development of the child may be divided into periods when growth in length dominates and periods when growth in weight is most prominent. A comparison of these periods, constructed from the viewpoint of weight and length, with the periods of metamorphosis, shows that they coincide curiously in their alternations. That is, the phases of length growth coincide with the phases of metamorphosis, when the teeth and sexuality change. The phases of weight growth correspond to the periods between the metamorphoses.

Now, what clues have we to the mechanics of these periods of metamorphoses? They occur within fairly fixed age limits. What causes and controls them? *Each period of metamorphosis is associated with a preceding increase of activity of an endocrine gland, or with a decrease.* Thus it has been shown that the thyroid of the new-born infant contains no thyroxin, for its thyroid contains no iodine, which is an essential constituent of the thyroid's hormone, thyroxin. Moreover, the smallest blood-vessels of the skin, the capillaries of the new-born infant, which can be observed directly under the microscope, show certain specific characteristics, peculiar windings and twistings, which have been found also only in the cretin or cretinoid idiot who is born without a thyroid. In other words, every new-born infant is a potential cretin. These cretin-like properties of the skin capillaries disappear after the first few weeks or months of life, probably as iodine is deposited in the thyroid or taken up by the thyroid, and the active production of thyroxin begins. At the same time certain changes appear in the gums of the infant, and there is a complete transformation of its metabolism, particularly of the mineral salts. Then the first teeth erupt.

A disturbance of this transformation will be ac-

companied by various abnormal manifestations, including delayed eruption of the teeth, or irregularity of the time and character of the eruption of individual teeth, or defects of their structure. In the cretin the eruption of the teeth is delayed for months or even years.

All the evidence, therefore, tends to show that a certain concentration of secretion in the thyroid, and hence in the tissues, is responsible for that remarkable metamorphosis of the infant which is usually passed over as the first dentition. To estimate the part which the thyroid is to play in the history of the particular individual is of the greatest importance to those interested in the child.

During the first two years of life the pituitary gland is also stimulated by the thyroid gland. For it grows during this time relatively more quickly than the rest of the body. With the cessation of the first metamorphosis, the completion of the first dentition, its relative and absolute growth continue to parallel that of the body as a whole. But it plays a most important part in the second metamorphosis, when the permanent teeth erupt.

This second metamorphosis, occurring between the fifth and seventh years, is not so definitely associable with a period of preceding increased ac-

tivity of a single gland. But it is associated with a remarkably decreased activity, which may even go on to complete atrophy, of an important hormone-producing organ, the pineal gland. This occurs usually at six, but may occur as early as five or as late as seven. In two children, whom I observed personally, suffering from a destructive tumor of the pineal gland, one aged three years and the other four and a half, the earliest sign of the disease was a premature falling out of the temporary teeth, which preceded the appearance of other symptoms of the disease by months. With the full efflorescence of the disease the permanent teeth appeared. This, taken together with the fact of a normal change in the pineal during the second metamorphosis, points to a relation between its diminution of influence in the organism and the eruption of the permanent teeth.

Concomitantly, there is a wave of chemical disturbance and change which profoundly affects the nervous system and mind. The child of seven is an individuality with the outlines of the future adult apparent. There comes to view the quality of what might be called its intellectuality, as well as its character.

We must, therefore, consider the rôle of another

gland of internal secretion, the pre-pituitary, which has much to do with the development of the intellect. As noted, there has been observed between the fifth and seventh years a distinct acceleration of growth in length, which all admit is functionally regulated by the pre-pituitary. In a series of measurements of children during this age period it was found that the increase in height is due to growth in length of the leg in relation to the thigh, a fact which implicates the pre-pituitary.

It would seem, therefore, that the second period of metamorphosis is initiated by the atrophy or decrease of activity of the pineal, releasing an increased activity of the pre-pituitary. If there is not sufficient weakening or withdrawal of the pineal influence, or insufficient development of the pre-pituitary dominance, we find a persistence of one or more of the temporary teeth, a delay in the eruption of the permanent teeth, and a general relatively infantile condition, with other bodily and mental defects. Sometimes these can be controlled by proper treatment directed at the fundamental process, the disturbed balance of relations among the endocrine glands at the particular age period.

The third period of metamorphosis, and the

only one generally recognized as such, is the metamorphosis of puberty, or adolescence. It is difficult to state just when it begins, that is, to measure accurately the date of its initiation. Psychically it may begin as a vague curiosity. Physically the story is different.

During the eighth, ninth, and tenth years the body increases more in volume than in length. With the eleventh year, length or height increase overtakes volume or weight increase and then passes it. The basic process associated with this is probably responsible at the same time for a stimulation of the sex-gland's secretions. Adolescence and sexuality, increasing emergence of the secondary sex characters, the characters which distinguish the sexes, herald the appearance of the third metamorphosis.

Literally the word "puberty" means becoming hairy. The earliest gross sign of sex development in the male is generally the appearance somewhere of the sex hair. In the female it is the enlargement of the breasts. Every one admits the dependence of this third period of metamorphosis upon the internal secretion of the gonads or sex-glands. That was determined by domestic experiments in the earliest historic times. At the same time there is diminished the

influence of another gland of internal secretion, the thymus. One thinks of the passing of the pineal, which occurs with the second metamorphosis. During puberty the pituitary gland doubles in weight, which is an indication of the amount of work it is called upon to do.

In all three metamorphoses other glands like the adrenal glands and the parathyroid glands may play a dominating rôle. If they become insufficient, hyperactive, or diseased, a modification of the particular metamorphosis, showing its effect in the teeth as well as in the rest of the body and in the soul, will be produced. Infectious diseases of childhood, like diphtheria or scarlet fever or mumps, during one of the periods of metamorphosis, frequently damage one of the endocrine glands, with effects upon the personality of the individual which last for the remainder of his life.

No one can exaggerate the special importance of the prevention of the infectious diseases of childhood, and of their proper care, *particularly during the periods of metamorphosis,* for the prevention of disastrous disturbances of the constitution and personality of the individual. Children who have suffered from any of the infectious diseases should be carefully watched. They

should be observed at frequent intervals for the appearance of the earliest signs of disturbance of function of one or other of the glands of internal secretion. There are numerous cases recorded of glandular affections precipitated by one of these diseases. The proper glandular classification of the child by the physician before or during the course of the infectious disease will assist him materially in foreseeing and responding to the changes to be expected.

In the school-room, as well as in the responses to social needs and adaptations, the study of the child's endocrine glands is of infinite importance. Undoubtedly the appreciation of the influence of the internal secretions upon mind and behavior will yield the most valuable results for the child as well as for the community. Only the broadest possible outlook upon and contacts with life can fit the parent coöperating with the practitioner to cope with the problems involved. Too often the ignorance of the parent and the indolence of the teacher defeat the salvation of the child.

CHAPTER VI

SHAPES AND SIZES

EVERY human being is built according to the specifications of a body plan. As a house is built of stone or wood according to the architect's blue-prints, so the body is constructed of bone in proportions of length, breadth, and thickness which the eye measures instinctively as right or wrong, normal or abnormal. Indeed, certain students of the subject have attempted to reduce the normal plan of body build to a formula. Among these have been minds as far apart as professional anatomists and great artists.

The relation of different parts of the body to its height has been a favorite hunting ground. Leonardo da Vinci, Dürer, Michelangelo, sought to express their sense of the exquisite harmony of the body proportions in the most fantastic conceptions. Mathematicians and anthropologists have attempted to express these relations in simple figures.

The tape-measure has shown certain interesting

ratios. One is the fact that the span, or the distance from the tip of the middle finger of one hand to that of the other when the arms are held extended, is equal to the height. Then if a person is five feet eight inches tall, or sixty-eight inches, his span will also be sixty-eight inches if he is normal in that respect.

The growth of the skeleton sets the pace for the growth of the soft parts of the body. And so harmony or disharmony of proportions manifestly will depend upon the rate of growth of different bones. One of the greatest mysteries of biology is, has been, and perhaps always will be the question of the wonders of form exhibited by living things. One tiny cell, by making itself over and over and specializing in its various reproductions, makes itself into a complication of parts which has been the marvel of every reporting mind. Yet from the chemical viewpoint it is all a matter of a due supply of materials and a regulation of the rate at which these materials are supplied to different parts and of the rate at which they are consumed. Both these processes are controlled by the glands of internal secretion.

The embryo, out of which the bones grow, is at first like a jelly. Certain parts of the jelly become changed into firmer, more resistant tissue

known as cartilage or gristle, by the formation of a peculiar sulphuric-acid-containing substance known as chrondrin. For all bones, except those that are flat like those of the face and cranium, this process of gristle growth is a precursor. Within these cartilage areas, phosphorus and lime compounds are deposited, in definite proportions, and they confer upon the tissue the solidity of bone. The bones grow in length and thickness by a greater and greater extension of the process of lime deposition.

During the entire period of growth there is an area at the upper and lower ends of the bone, in which first cartilage is produced, and then bone from the cartilage. This area is called the epiphysis, and its recognition is important. For it is a valuable indication of the true age of the individual, as each epiphysis of each bone disappears, by final transformation of itself into bone, at a definite age. This is technically called its closure. Since in the X-ray pictures of bones the epiphysis can be recognized apart from the rest of the bone because of the absence in it of bone lime, one may deduce the true age of the individual if he is normal. If he has had an abnormal development, particularly if there has been a disturbance of the internal secretions controlling the growth of

bone, of the thyroid or the pituitary or the sex-glands, the epiphysis will not be normal in the X-ray picture.

By comparing X-ray pictures of the hands of normal people at various ages with those who present the symptoms and signs of glandular deficiencies or excesses in development, much information has been gleaned concerning the gland basically at fault. Thus in the development deficiency of the thyroid gland of the cretinous idiot the epiphyses of all the bones are delayed in their permanent transformation into bone.

When the thyroid is removed from a young growing animal there results a marked retardation of bone growth, so that in the course of a few weeks it is evident that a dwarf has been artificially created. As all the bones are involved, the head too is affected, and the brain becomes concomitantly smaller. In those suspected of suffering from cretinism, inborn deficiency of the thyroid, which may be present in all grades and degrees, from the slight, hardly recognizable to the grossly obvious, X-ray pictures of the hand will show an absence or a poor evolution of the wrist-bones, as demonstrated by the absence or faintness of the shadows in the plates. All the bones of the body are thus more or less affected,

so that the individuals appear dwarfed or generally stunted.

On the other hand, in cases of pituitary defect or excess, it is the long bones, those of the thighs and legs, the arms and forearms, that are particularly affected. The two internal secretions which seem to bear most strongly upon the ends of the long bones are the pituitary and sex glands, also known as the gonads. Indeed, there is a sharp antagonism between these two. The pituitary tends to keep the epiphysis open and so to produce a longer bone. The gonad acts to eliminate and close the epiphysis and so produce a shorter bone. Consequently, in conditions of disturbed balance between the pituitary and the gonads, there will be an overgrowth or undergrowth of these parts of the body, with the production of proportions which the eye recognizes as abnormal and labels unnatural. Thus various lanky, lofty, floppy, or dwarfed people may be the outcome of a break in the balance between the pituitary and the gonads, occurring either before birth, during childhood, or during adolescence. If the individual has poor gonad function with excessive pituitary stimulation, there will be an overgrowth of the long bones compared with the trunk, and the individual may be described as long and lanky.

If conversely there is not sufficient action of the pituitary, with an accompanying or following weakness of the gonad drive, the individual will be small-boned and undersized. It is easy to call to mind people as well as portraits of historical personages who present these characteristics.

These relations are thus seen to be more subtle than would seem at a glance. We cannot say, let us propose a prize for the intermarriage of giants, as was recently suggested by a so-called philanthropist, to create a larger and stronger race. The giant like the dwarf is the expression and victim of a glandular unbalance. It is more than probable that all he would hand down to his offspring would be a tendency to trouble in the domain of the internal secretions, manifesting itself in conditions as various as diabetes, mental deficiency, or nervous instability culminating in nervous breakdown.

The interest in shapes and sizes, and in stature particularly, is universal; some one once said that it was more important to add one inch to the average size of a population than to educate it. The revelation of the mechanics of bone growth knocks that cleverism into a cocked hat. In general it has been shown recently that on the average taller people are brainier than shorter people; this state-

ment, however, must not be taken too seriously.

It all comes down to the eternal question: what is the normal? We all admit that there is no actuality of the normal. In practice every one is accustomed to certain standards and rules for placing people and their reactions, which make for a definite distinction at any rate between the usual as the normal, and the unusual and freaks as the abnormal. The unique quality of every person, it is true, defies that supreme lust of the intellect, the lust for classification and standardization. Yet merely looking at the shape and size of him or her, there are apparent characteristics which the eyes and brain seize upon for comparison quasi-unconsciously, with a sort of composite photograph of the normal most of us carry about with us in our thinking. That holds in particular as regards different shapes and sizes of people.

So the relations between the parts of that curiously forked animal, Mr. X, who is before us for the solution of the mystery of his personality, may be subjected to scientific analysis. Particularly interesting have proved the relations between the bulk of the trunk, consisting of the chest and the abdomen, and the extremities, upper and lower, the limbs, spoken of somewhat incompletely as the arms and the legs.

Recently investigations have focused attention upon a possible parallelism between intelligence, as measured by intelligence tests, and the relative size of trunk and extremities. One investigation, that of Naccarati, deserves special notice. He found that in several hundred college students there was a certain correspondence between the degree of alertness of the intelligence and the degree of development of the limbs as compared with the trunk. In other words there is a tendency for a certain kind of body build and a high grade of intelligence to run together. Naccarati concluded that this correspondence was probably an expression of a dominance in the personality of a gland or glands of internal secretion.

The method used was the method originally worked out for work of this sort by di Giovanni and Viola, Italians, physicians and students of man. It consists in the establishment of a ratio or index expressing the relation of the trunk to the limbs. This is called the morphologic index. It may be obtained by dividing a figure representing the trunk volume (chest capacity plus abdomen capacity) into a figure representing the total length of the limbs—the length of the upper extremity from the shoulder to finger-tips, added to the length of the extremity from hip to foot.

These figures may be procured by any one with a tape-measure, calipers, and some patient practice. The trunk is equal to the bulk of the chest added to the volume of the abdomen. These may be determined as one would determine the cubic contents of any body—getting length, breadth, and depth or thickness and multiplying them.

For the chest, the length of the breast-bone may be taken as the length, the distance between the breast-bone and the spine as the depth, and the distance between the armpits as the width. Multiplying these dimensions gives the upper chest bulk. The lower may be obtained by measuring from the abdominal end of the breast-bone to a line on a level with the last ribs, then multiplying that by the chest depth and the width (distance between ribs) at this level. Adding upper chest and lower chest values gives us the total chest value.

The bulk of the abdomen is determined by measuring its width and depth at the waist, then multiplying them by the length of the abdomen, as measured from the last rib level to the hip level. The length, width, and depth of the abdomen multiplied give its volume. That, when added to the chest volume, provides the total trunk volume.

The length of the limbs is determined by add-

ing the length of the upper extremity, from armpit to wrist level, to the length of the lower extremity, from hip level to ankle. This total extremity length is divided by the total trunk value, and the result is the index sought for, the morphologic index. Depending upon its value, three types of individuals are distinguished, the relatively long-legged (or microsplanchnic) in whom the fraction is between 0.035 and 0.048, and the relatively short-legged (or macrosplanchnic) in whom the fraction lies between 0.035 and 0.022, while the relatively normal hovers about 0.035, when measurements are made in inches.

Long legs, small body; large body, short legs; or symmetrical legs and body thus turn out to be the possibilities. It may not be necessary to go through the trouble of all the measurements in examining a large group, say for employment purposes. For it has been found that the height-weight ratio approximates the results of the morphologic index determinations. The height-weight ratio is the height in inches divided by the weight in pounds multiplied by one hundred. If the quotient is between thirty-five and forty, the individual belongs to the normal group. If it is above fifty, the individual belongs to the long-legged, small-bodied, microsplanchnic group, while if it

is less than thirty-five, he is one of the short-legged, large-bodied, macrosplanchnic type.

No one should jump to conclusions that long legs and mental brilliance are synonyms or that squatness and stupidity are inevitable concomitants. A small trunk combined with long arms and legs means that the chances are that the intelligence is above the average, and that brain work is a desirable occupation; while, on the other hand, a large trunk combined with relatively short limbs means probably a plodding rather than a quick mind with a flair for an occupation that demands attention to routine rather than to speed and brilliance of accomplishment. In general, the long-legged microsplanchnic will make the good executive-inventor; the short-legged, macrosplanchnic, the dependable routineer. Employment managers and all those who have to do with employees will realize the importance of this generalization. As for the normal, other tests must be applied; but, then, he is a rare bird.

In view of what I have said concerning the relation of the thyroid, the pituitary, and the gonads to the development of the bones, it is easy to see that various combinations among these glands may occur which will offset these general rules. The eunuch, for example, in whom the

gonad influence is low, is one of the most striking examples of the long-limbed, small-trunked type. Yet he has not been noted for any special brilliance of intelligence or intellect. Quite the contrary. Also it is easy to point to the existence of stout squat scientists and long-limbed laborers. It is important to remember that all of the glands of internal secretion have an influence upon the development of the bones, just as all of them have an influence upon the development of the brain and nervous system. In general, long limbs and dominating pituitary and thyroid function go together. Viola claimed originally that the man with the small trunk and long limbs represented a type farther advanced in evolution than the normal man, who in turn represented an advance over the short-limbed, large-bodied man, evolution apparently aiming at an increase of size of the organs of adaptation, the limbs, at the expense of the organs of nutrition in the chest and abdomen. This typically abstract and grandiose nineteenth-century explanation may be discarded in view of what we now know of the concrete agents supplied by the glandular dominations in the development and make-up of the body.

It is an interesting fact that while a deficiency of the thyroid will cause lack of growth of bones

in length, they will also tend to become short, thick, and plump. Contrariwise, with pituitary deficiency, the bones are not only short, they are also thin and small. Hyperthyroid individuals often have long, slender bones; and slim, tall people frequently may be classified as the thyroid, overactive type.

Removal of the parathyroids, the tiny glands in the neck situated at the sides of the thyroid, will cause an interference with the handling of lime by the bone cells as by all the other cells. Consequently the bones become soft, like those of children with rickets. For it is the lime content of the bones that gives them their firmness and solidity. In contrast, persons with excessive parathyroid action will have bones that are more brittle and fracture easily because of a too great content of lime. These cases are seen sometimes in women, and also in men, after the sex change of life so called, when the sex-glands withdraw from the scene.

The rôle of the thymus, placed in the chest above the heart, in the construction of bone and in the architecture of the physical personality cannot be dogmatically stated. Nevertheless, there is much evidence that it is an antagonist of the parathyroids as also of the sex-glands. In-

dividuals in whom there is over-function of the thymus (who always present other signs that stamp them as "peculiar") show in the bones the effect of relative parathyroid defect and lime deficiency. As children they often have rickets. There is a tendency also to a general bodily conformation that reminds one of the opposite sex—in the male, of the female; in the female, of the male.

The typically small-boned, round-headed dwarfs that are the outcome of pituitary lack contrast sharply with the giants who are created by pituitary overactivity before and during adolescence. Giants have always interested human beings. Mr. H. G. Wells once developed that interest in one of his fascinating romances, "The Food of the Gods." With typical clairvoyance he anticipated one of the looming possibilities of the future. In his story, the absent-minded professor discovers a substance which causes things to grow and proliferate all over the place. As a result, giant rats, grotesque plants, and finally gigantic human beings are produced who come to conflict with the ordinary every-day standards of ordinary every-day standardized people. The recent separation of a substance from the anterior pituitary gland, with which giant rats have been produced by feed-

ing, adds another to the list of Wells' successful anticipations.

Midgets and giants are freaks. But the study of freak phenomena has always provided us with clues to the most intimate secrets of artificial feeding of gland extracts. Lizards are the descendants of dinosaurs who were half a block long. The examination of the skulls of these dinosaurs showed that they must have had enormous pituitary glands.

By some remarkable occult method a gentleman named Henrion once estimated that the height of Adam was about 120 feet, and that of Eve about 110 feet. On this basis, the Tree of Knowledge of Good and Evil from which Eve plucked the fatal apple must have been of corresponding size. The Garden of Eden, in fact, appears to have been built on a grand, glorious, gigantic scale. The Fall of Man involved a degeneration of his bones as well as of his soul.

The fact of the matter is that we are by no means the descendants of giants, who are curiosities of nature's experiments with the glands of internal secretion. So are dwarfs and midgets. And dwarfs are often intellectual giants compared with the pygmy intelligence of true giants. At the congress of giants and dwarfs of her em-

pire, gathered once for the delectation of an empress of Austria, the dwarfs made things so wretched for the giants that the latter had to appeal to the officials for protection. Giants have been described as being ten feet high, but most authentic examples have varied between seven and one half to eight and one half feet. These figures are by no means to be sneered at, particularly when contrasted with the diminutive proportions of the midget, who can best appreciate the sizes. Charles I of England had a giant bodyguard who was accustomed to carry a dwarf about with him in his pocket. There is emphasis of the same sort in the famous wax-figure museum of Madame Tussaud in London. Most striking is the wax figure, eight feet five inches high, of a drum-major of the Imperial Preobrajewsky Regiment of Guards, once the pride of Russia. In his palm stands pathetically upright the reproduction of the dwarf of world-wide celebrity, General Tom Thumb.

John Hunter, celebrated in the history of medicine for his researches in anatomy, surgery, and pathology, had an insatiable interest in giants. One of his contemporaries was an Irish giant named O'Brian, about eight and a half feet tall. Hunter asserted publicly that he would perform

Raphael (Raffaello Sanzio), a Self-Portrait
Showing the facial characteristics typical of the thymus-centered individual

a post-mortem on the body of the giant, and secure his skeleton for his collection of pathological specimens. O'Brian swore that nothing of the kind would ever take place. Hunter repeated his assertion a number of times and spent a large sum of money in tracing the movements of the poor unfortunate, who sought always to escape him. O'Brian died in his youth, as so many of his condition do, but provided that his body should be weighed down with weights and then deposited in the Irish Channel. Some fishermen, whom he had paid for this posthumous service, decided that Hunter would now be willing to part with more money, and that they could thus double their wages. They were right. So the Englishman finally outwitted the Irishman. The skeleton and even the kettle in which it was prepared, are on view in the museum of the Royal College of Surgeons in London. Altogether, it cost Hunter almost twenty-five hundred dollars, which was a fortune in his time.

Another interesting case is that of John Turner, the details of whose life-history have been reported by Cushing. Shortly after his adolescence began—adolescence is the period of great turmoil among the glands—he commenced to grow excessively. He admitted having regularly taken

during this critical period a pint of whisky for breakfast for some time. Whether this had anything to do with his abnormal growth, and whether alcohol has some specific stimulating effect on the pituitary gland, cannot be said. At any rate he consumed enormous quantities of food because of his insatiable appetite and soon attained the height of eight feet three inches. The enormous bones of the face pushed his ears far to the back of his head. His hands and feet were huge. Shoes had to be made for him one and a quarter feet long, and he wore children's undershirts as socks, quite like the ogres of ancient fairy-tales. But it needed no Jack the Giant-killer to destroy this poor giant. His enemy was within, as revealed by an X-ray examination of his skull—an enlargement of his pituitary gland, which oversecreted and produced what was really a disease. For when oversecretion of the pituitary is due to or associated with under-function of other endocrine glands there is a weakening and failure of many bodily functions.

When the pituitary gland secretes more than it should and the other glands at the same time are adequate, the big-boned, large-jointed man is evolved, with prominent jaw, high cheek-bones, and evident knuckles. Hands and feet are char-

acteristically large and often spade-like. The teeth, the ears, the nose and lips also attract attention by their size. The pituitary has a tremendous part to play in the architecture of the individual. But it should always be remembered that the other glands of internal secretion all have an influence in retarding or accelerating the influence of the pituitary. One of the most prominent of them is the thymus, as has been mentioned. In women, the earlier menstruation appears, the sooner growth ceases, because of the antagonism between the pituitary and the sex-glands, the gonads. So in warm climates where menstruation begins earlier than in cold climates the women are shorter.

Tallness often runs in families. Students of genetics have demonstrated that a tendency to high or low statures is a definitely inheritable trait which can be studied by their methods. The present writer has studied a number of families in which all of the children were strikingly tall, or strikingly short, and obtained evidence of a dominating influence of the pituitary gland. Illustrative are interesting examples of tallness in a family of two boys and one girl. The girl, eleven years old, was brought originally by the father because he was alarmed by the continued rapidity of

her growth. She had attained the height of five feet seven inches. He envisaged the possibility of her becoming as tall as her brothers, one of whom had attained six feet four at the age of eighteen, and the other six feet two at the age of fourteen. The father was most anxious to have her growth stopped. Like fat people who wish to become thin, and thin people who wish to become fat, the tall people who wish to become shorter are almost as numerous as the short people who wish to become taller.

The father was a typical pituitary dominant individual, tall, broad-shouldered, generally large-framed. He was a financial genius who had made himself tremendously wealthy, although he began with almost nothing (according to his story). He particularly admired his own large wonderful teeth. His father had been a person of the same type (except as regards finance) and a musician of some note. His mother was of only average height, but his father was very tall. His wife was tall and belonged to the same hyperpituitary type (bony, cool-tempered, fond of meat), and her father had been notably tall. It would seem, therefore, that a concentration of tallness or, chemically speaking, of pituitary influence, had

been achieved in this family, visiting its effects upon the children.

The girl at birth weighed eight pounds. She was not nursed at the breast and did poorly during the first six months of her existence. She was by no means ever a fat baby or fat child. She began to walk at one year and to talk a little later. No definite information is available concerning the coming of the teeth. At about the age of seven she had measles, chicken-pox, and German measles in succession. This is important to bear in mind, for at about this time there was a retrogression of the pineal gland influence in the personality and a corresponding increase in the influence of the pituitary. She was therefore subjected, we may say, to extra stimulation of the pituitary at this time because of these diseases. And the fact is that there was a sudden increase in the rate of growth after this time. She seemed to be rising in the air by "jerky jumps," as the mother put it. She never had scarlet fever, diphtheria, or mumps, although she was exposed to them several times. Since the seventh year she had been subject to attacks of sick headache, the pain being marked in the forehead and over the top of the head (which again points to the pituitary).

She was always active physically and went in strenuously for gymnastics and outdoor sports and games. She always had an enormous appetite, and, as she said, when she had nothing else to do she ate. She had a remarkable craving for meat and could live upon roast beef three times a day, but she also made away with a large amount of sweets and pastry when permitted. No particular craving for water or other food was present.

Intellectually there was no particular distinction. According to her mother she had a definite musical talent but was lazy and so refused to develop it. In school no subject was specially attractive, and she obtained average ratings in mathematics. A remarkable fact about her dentition was the appearance, with much pain, of her last wisdom-tooth during the past year, when she grew most rapidly.

She weighed 103 pounds and presented evidence in her bodily measurements of an excessive growth of her lower extremities and, to a less degree, of her upper extremities. She, therefore, belonged to the long-limbed, short-trunked type. Her head was long and narrow, and her hair-line —that is, the line where the hair stops growing— was high both in front and behind. This suggests

a certain amount of thyroid overactivity during development. The color of her teeth was a pearly white, but the size varied. The central cutting teeth were large, square, and quite prominent, but those beside them were smaller, and somewhat displaced; in other words, irregularly erupted. The last circumstance always suggests some difficulty in ovarian function. The thyroid gland was enlarged and showed other evidence of over-functioning. There was some development of the breasts, but she had not yet begun to menstruate.

The problem she presented was somewhat clarified by the data X-ray examinations provided. They showed that there was present a large shadow in the chest above the heart, corresponding to the anatomical position of the thymus gland. The skull showed the bony cradle of the pituitary gland, the sella turcica, eroded in front. The interpretation of this phenomenon, in the light of past experience, could only be that the pituitary gland, enlarging as the effect of some special stimulation, was in fact wearing away the bone in front of it. The X-ray picture of the hand showed that the development of the bones had proceeded to the stage usually seen at about the age of fifteen, although the girl herself was

only eleven years old. The correlation of these three rather definite findings leads one to the conclusion that some stimulus was causing the pituitary to overact, and so forcing a development of the bones prematurely and excessively. The chemical examination of the blood showed an excess of sugar and alkali, a combination which has been found in conditions of pituitary over-function in adolescence. Upon the view that the thymus was the crux of the situation, the thymus was made to shrink in size by the X-ray treatment, and glandular feeding antagonistic to the pituitary was instituted. Growth ceased in three months, and menstruation began one and a half years later.

This girl's story is interesting because it illustrates so plainly how distinct is the glandular control of growth of the stature and proportions the body attains. The reason why she was subjected to treatment was the curious social one, that to be too tall is for a woman a distinct disadvantage, because the custom of the country turns thumbs down for a woman who is over height. Yet her brothers, one of fourteen and really a giant for his age—six feet two—and the other of eighteen, six feet four, were by no means convinced of an objectionable quality in their stature.

They were both great meat lovers, capable of enjoying it three or more times a day; they were both fond of water and excelled at school in mathematics and music, but did poorly in the languages, including English. No attempt was made to interfere with their growth. The younger one attained six feet four and was a fair socio-economic success; the older reached six feet five and died of diabetes, which appeared suddenly.

Dwarfs have always interested mankind as much as giants. Among the ancient Hebrews they were not held in high honor since they were forbidden to act as priests at the sacrificial ceremonies. On the other hand, they were greatly valued by such important personages as the Roman emperors, who all had their favorite dwarfs. The more grotesque their appearance, the greater their value, and so in response to the demand they were artificially manufactured from children by causing them to perspire excessively or rubbing into the spinal column fat obtained from bats. Even nowadays jockeys are said to be stunted by similar methods.

Moreover, it was the fashion in both ancient and modern courts as well as those of feudal times to have dwarfs not only as grotesque as possible

but also as clever as possible. Perhaps the model all sought was an Æsop, immortal narrator of fables, who was a slave dwarf. There is a well-known marble figure of him in the Villa Albani at Rome which exhibits him as a repellingly ugly and deformed pygmy. In his personal character he is represented as possessing the characteristic qualities of many dwarfs; he is supposed to have been put violently to death by the people of Delphi as punishment for his theft of a silver cup, or for the appropriation of a donation made to the poor by Crœsus, or even simply for his chronic sarcastic insults of the citizens.

In the Middle Ages the court jester was often a witty dwarf. Peter the Great was a dwarf collector, as Frederick the Great was a giant collector; the statement illustrates the profound difference in their temperaments. In 1710 Peter provided a marriage of truly imperial sumptuousness when he united his own favorite court dwarf to another, inviting seventy-two dwarfs to the wedding.

Of English dwarfs the most famous was Geoffrey Hudson. Henrietta Maria, wife of Charles I, received him as a gift in a pie, out of which he stepped and made his bow to the queen, who adopted him. He was then eight years old and a

little over twelve inches in height. He was the son of a butcher who tended the bulls of the Duke of Buckingham. Neither of his parents was short, but he remained about a foot and a half tall until he was thirty. At that age he was captured by Turkish pirates, and, as he afterward asserted, his sufferings made him grow so that he became three feet nine inches, more than double his height; and this happened after he had remainded stationary for more than twenty years. Not to be insulted by any one, he once challenged to a duel an adversary, who arrived with a squirt, to advertise his opinion of the encounter as a joke, but who was killed by the fiery little dwarf, who shot him from horseback, a position which he had demanded as a means of putting them on a level. Davenant celebrated Hudson in a famous comic-heroic poem concerning his battle with a turkey-cock. In the first English Civil War Hudson became a soldier and attained the rank of captain of cavalry. Truly he was a great soul in a tiny body.

In the light of this and similar histories of miniature men, giants seem mean-spirited creatures, devoid of wit, audacity, or adventure in their lives. But the average normal humans have always regarded the one or the other as merely

amusing or useful freaks, not to be adopted as models. One of the dwarfs of the Bohana family was used in the French Revolution as a despatch-bearer for the royalists, moving about in and out of Paris as a baby in a nurse's arms. Yet despite the many personal and intellectual attractions of dwarfs kept in choice families, a favorite sport at dinners consisted in pitching them about, from one guest to the other, like balls, to show their playful mood or assure the host of the quality of their humor.

In further contrast to giants, dwarfs are often long-lived, sagacious, and prolific. Richard Gibson, another dwarf pet of Queen Henrietta Maria, miniature painter and drawing-master, married a dwarf, Jane Shepherd, who bore him nine children, five of whom attained maturity as normal-sized adults. There are numerous instances on record of dwarfs whose children possessed ordinary proportions.

Dwarfs should be distinguished from the pseudo-dwarfs who are hunchbacks. The Spanish court, at the time of its glory as the seat of the great Spanish Empire, satiated its curious lust for the monstrous, as Oscar Wilde once said, by seeking these cripples to tickle its jaded palate. In one of his loveliest stories, "The Birthday of the

Infanta," the atmosphere in which these monstrosities moved and breathed is subtly recreated. It is a story of how a poor wild hunchback, who has never before seen himself in a mirror, is brought before the beautiful princess royal, the Infanta, on the occasion of her twelfth birthday.

But the funniest part of the whole morning's entertainment was undoubtedly the dancing of the little dwarf. When he stumbled into the arena, waddling on his crooked legs, and wagging his huge misshapen head from side to side, the children went off into a loud shout of delight, and the Infanta herself laughed so much that the Camerera was obliged to remind her that although there were many precedents in Spain for a King's daughter weeping before her equals, there was none for a princess of the blood royal making so merry before those who were her inferiors in birth. The dwarf, however, was quite irresistible, and even at the Spanish Court, always noted for its cultivated passion for the horrible, so fantastic a little monster had never been seen. It was his first appearance, too. He had been discovered only the day before, running wild through the forest, by two of the nobles and had been carried off by them to the palace as a surprise for the Infanta, his father, who was but a poor charcoal burner, being but too pleased to get rid of so ugly and useless a child. Perhaps the most amusing thing about him was his complete unconsciousness of his own grotesque

appearance. Indeed, he seemed quite happy and full of the highest spirits. When the children laughed, he laughed as freely and joyously as any of them, as if he were really one of them, and not a little misshapen thing, that Nature, in some humorous mood, had fashioned for others to mock at.

Then when he sees himself for the first time in his life in a mirror.

It was a monster, the most grotesque monster he had ever beheld. Not properly shaped, as all other people were, but hunchbacked and crooked limbed, with huge lolling head and a mane of black hair. The little dwarf frowned, and the monster frowned also. He laughed, and it laughed with him, and held its hands to its sides, just as he himself was doing. He made it a mocking bow, and it returned him a low reverence. He went toward it, and it came to meet him, and copying each step that he made, and stopping when he stopped himself. When the truth dawned upon him, he gave a wild cry of despair, and fell sobbing to the ground. So it was he who was misshapen and hunchbacked, foul to look at and grotesque. He himself was the monster, and it was at him that all the children had been laughing, and the little princess who he had thought loved him, she too had been merely mocking at his ugliness and making merry over his twisted limbs.

We know to-day that most hunchbacks have been the victims of tuberculosis of the spine. That there may be a certain beauty in horror was demonstrated by Velásquez in his immortal portraits of the hunchbacks of the court of Philip IV of Spain. But true dwarfs, the outcome of disturbed relations between the pituitary, thymus, and sex glands, may be quite gracile and even beautiful, though miniature human beings. Velásquez has also immortalized the delicate prepossessing representatives of the type who delighted the Spanish court. Thus his "Don Antonio el Inglés" (Don Anthony the Englishman), with his dog, a large animal who emphasizes the true stature of his master, figures a dwarf of truly noble demeanor. In another famous painting "Las Meninas" (The Maids of Honor), now in the Madrid gallery, one sees the Infanta Margarita María surrounded by her ladies in waiting, her mastiff, and her male and female dwarfs. Other dwarf buffoons he has painted not as half-witted deformities but with a delicacy and sympathy which attracts and holds the spectator. There is a gentle and kindly understanding in the portrait of the dwarf Sebastian de Morra which should appeal even to the leveling standards of a democracy.

That dwarfs are the expression of disturbances of the balance among the glands is suggested by the other features of their development. They often fail to lose their milk-teeth; they may have a lack of hair development on the face and body and lack other characteristics of an adult, sexual and otherwise. In recent years a number of them have been studied with modern methods and have shown disturbances of the pituitary gland. Dwarfs have also been described as the outcome of thyroid deficiency. There was probably early and continued over-secretion of the sex-glands in the court jesters whose bulldog-shaped heads and bodies and waddling gait went with minds that were talented, loquacious, prompt at repartee, and sexually extremely susceptible and varietist. This type is frequently transmitted in families.

Important as the glands of internal secretion are, however, in determining shapes and sizes and contours of people, it should not be overlooked that the tissues, including the bones, have an inherent growth tendency of their own, which varies from person to person. This inherent power to grow and the glandular influences may reinforce one another or may be antagonistic. The results may be imagined. But it is when we come to

questions of control, of assisting or hindering, growth and development through glandular feeding, injection or other treatment, that the tremendous significance of the great rôle of the internal secretions becomes apparent.

CHAPTER VII

FACES AND THEIR DECORATIONS

THE face, incarnation of all the needs, desires, instincts, and passions of protoplasm, presents to us the whole past of the individual as well as the complete history of all life. For in the changes that the face undergoes from infancy to senility, from the pudgy roundness and softness and pinkness of the baby, through the callow smoothness of the adolescent, the markings of character that appear during youth, the permanent tracings of experience and disease in middle age, and the transformations of old age, there is not only an epitome of the life-story of the individual, but also a recapitulation of all the great strivings of his species, and indeed of all living matter. The shape and size of the head, the eyes, the nose, the mouth, all bespeak ancient strivings, experiments, and creations of the forces of life. Each of them represents one of the prime cravings of protoplasm, inventions and discoveries hit upon in the struggle to dominate the realities about and around it.

That is what one should always think of in looking at a face, that it is the front that life advances to a hostile, dangerous, challenging world. Once protoplasm was all of a piece, all the same in all of its parts. When it learned the value of having a more sensitive part of itself to use as a detector, a testing agent for whatever it brushed against or came into contact with, it created the head and concentrated there its organ of memory, the brain. It developed a bony case to shield the fragile gray matter, wherein it stored its experiences. It developed little outgrowths of the gray matter of the brain, cells which manufactured a pigment sensitive to light and color, and so evolved the eye. Possibly long before that it had evolved a prototype of a nose, responsive to whiffs and odors, when flying molecules of substances impinged upon other vanguard cells of that same brain. Chemical sensitivity perhaps preceded light sensitivity by ages. As we shall see, an association between the nose and intelligence has long been an axiom of popular tradition, which has recently been subjected to scientific investigation. And last, but not least, came the mouth, mode of ingress of food and prey, opening and shutting in attitudes of welcome or repulsion, attraction or disgust, and becoming with the de-

velopment of the teeth, an organ of attack subsidiary only to the limbs, and thus expressing combinations of emotion, so that one may distinguish between the curl of a lip that reveals only the lower teeth and the snarl that exhibits the fighting canine. All of the components of the face have become associated with the expression of intelligence and emotion, and all of them are regulated in their growth, development, and functioning by those fundamental regulators of intelligence and emotion, the glands of internal secretion.

There has always, from the beginning of mankind, been an intense interest in the face as an indicator of an individual's temperamental make-up. That one could tell facts about character from the face and guess tendencies of behavior from the suggestions of form and feature was the basis of a great literature in ancient and medieval times. It early claimed the methods and privileges of a science by virtue of its ability to predict some of the general lines of the future career of the subject. Thus, there is a tradition that Socrates appreciated the genius of Plato at a first view of his person. Plato himself relates how Socrates made a physiognomical diagnosis of Alcibiades and prophesied his elevation to high rank in the government of Athens on the basis of

it. On the other hand there is the story of a professional contemporary physiognomist, Zopyrus, who inspected Socrates himself and read stupidity and sensuality as the essences of his make-up. Whereat, the story goes, Alcibiades, who was a by-stander, broke into uncontrolled laughter.

That the subject was taken quite seriously by the Greeks is demonstrated by Aristotle's inclusion of it as one of the sciences. In a treatise attributed to him, there are six chapters devoted to the correlation with character of the expression and appearance of the face. He considers how character may be diagnosed in general, what deductions may be made concerning disposition, fearfulness or shamelessness, genius or mediocrity, and various points of weakness and strength in an individual. A favorite method of Aristotle's is to compare various features with those of animals. A slender hooked nose is said to be like that of an eagle, strong and grasping. A nose with a little break at the root like that of a farm fowl belongs to the luxury-loving. People who have noses that possess thick bulbous ends remind him of swine and are certain to possess the callous dullness of that animal.

Physiognomy was practised professionally among the Greeks and Romans. Nowadays there

has been a revival of various charlatanries in its name. We are not interested in these pseudo-scientific systems of guesswork, intuition, and shrewd observation. What we ask ourselves, as we inspect the face of Mr. X, is: what are the forces that have constructed the features and contribute to the expression that is characteristic for him, which in fact enables us at first glance to place him as Mr. X and not as Mr. Y or Mr. Z?

There is first of all the distinction to be made between the face static, the face as an architect or designer would look at it, and the face dynamic, the face as the psychologist or artist would read it. The latter, what is usually spoken of as the expression of the face, we may dismiss from immediate consideration, as most of us depend upon our instinctive ability to interpret expressions of the face either by our own past experiences or by mimicking the muscle actions involved. We read the face ordinarily for the manifestation of the emotion or emotions dominating the individual either temporarily or over a long period of time. Technically speaking, this side of facial interpretation is regulated by the mimetic innervation; that is, by different nerve mechanisms which work together to produce the well-known expressions of grief, anger, joy, contempt, and so on. The work-

ing of the mimetic mechanism is determined in part by the condition of the involuntary nervous system and in part by the individual's psychic status.

It is when we come to consider the face as an organization, as a complex of impressions radiating from skin, fat, muscle, bone, and blood arranged according to a more or less esthetic plan, that we encounter data throwing light upon the core of the personality. For skin, fat, flesh, blood, and bone are made by the same forces which construct the nervous system whose functioning is the mind. These forces are fundamentally chemical forces, and thus attention is again directed to those regulators of all the chemical reactions which go on in the body, the internal secretions.

True, the specific familial characters of a face, such as the shape and length of the nose, the contour of the jaws, and so on, must be determined by the something the individuals of a family have in common, by reason of their origin from the same or approximately the same material. These inherent or autochthonous family qualities are determined in part by the fact that individuals of the same family tend to have the same glandular make-up.

All the glands of internal secretion enter into the hereditary facial influences. They rule those reactions in the fore part of the developing individual which becomes the face, because all of them without a doubt influence the metabolizing chemical mixture out of which the facial bones, the eyes, ears, nose, jaws, teeth, chin, are, as it were, precipitated. Our knowledge, of course, is greatly limited as to just what the precise influence is upon the face of thyroid and parathyroids, pituitary and pineal, thymus and adrenals, gonads and their accessories. That is to say, we cannot to-day name everything they do. But because we have seen certain changes in the face associated with changing particular glands, the face has become of the greatest importance in diagnosing the glandular make-up of the man or woman behind it.

In consequence, students of endocrinology have become accustomed to speak of types of faces or the "endocrine facies." Thus the expressions "cretin facies," "adenoid facies," "eunuchoid facies," represent pictures, truly composite pictures which the trained observer recognizes as diagnostic of the glandular condition behind them.

But it is not enough merely to summarize mechanically observed faces in various individuals

with different glandular dominances. One must look upon every face as a design etched by the interplay of two great sets of forces: (1) inherent growth energies of the local cells, and (2) the glandular accelerations or retardations of their natural tendencies which exaggerate or clip the form and substance they would of themselves have evolved.

From this point of view, interest centers first upon the bones of the face. Their development determines their primary lines, the sketch of the face, so to speak. They influence such characters as the width between the eyes, the height and prominence of the cheek-bones, the mode of origin of the nose, its length and thickness, the extent and angle of evolution of the upper jaws and the lower jaws, the width and height of the forehead. The *scène en mise* for the face is the bony background about which the muscle, blood, fat, and skin are draped.

The thyroid has a tendency to make bones grow long and thin, when it is over-secreting. It therefore tends to elongate and ovalize and refine the face. When it is not secreting sufficiently, the bones tend to shorten and thicken. The more flat and squat type of bony design then results. The pituitary makes bones overgrow both in length

and width. Consequently when the pituitary is over-secreting the face is coarsened by the large bones, such as the jaws, cheek-bones, and nose. When the pituitary is under-functioning, the bones remain slender and under-developed, giving the face a fragile, infantile effect. The total effect of the face in such cases is of course small. A small head generally goes with it. Each of the other glands has an influence, some reinforcing, others neutralizing, upon the chemical reactions that are the thyroid and pituitary influences. Out of, as it were, a parallelogram of forces, the modeling of the face becomes more or less sharply defined.

The bony landmarks of the face evolve at different periods. They then provide clues to the state of the internal secretions in the individual at the time they were developing. Those clues are most important, for they tell us something about the endocrine past of an individual. At the time of examination his glandular status may be quite different from what it was, say, twenty years ago, or during adolescence, or when he was a child or a baby. One must be careful not to draw absolute conclusions regarding *present* conditions from the indications of past performances.

Take, for example, the nose, a constituent of

the facial ensemble which serves so often completely to characterize its owner. To many, a face is a nose surrounded by . . . What interests one first about it is the difference in Mongols as distinguished from Caucasians in the evolution of the nose. The Mongol has a nose the root of which is depressed and below the area between the eyebrows. The Caucasian, on the other hand, is characterized by a well-developed, elevated nose root. We say that the Mongol is poorly nasalized, the Caucasian well nasalized.

Now, there are two interesting facts that are apropos. One is that the nose of every white or Caucasian baby is poorly nasalized; the depression of the root of the nose in the infant and child is a recognized character of the age period. The other is that the nose of the cretin is like that of the Mongol, no matter what the age period.

The explanation of these interesting facts lies in the circumstance that during infancy the nasal bones are joined to the rest of the skull by a piece of cartilage destined to become bone under thyroid stimulation. This transformation in the Caucasian takes place during the latter years of childhood and is completed during adolescence. If during this time there is not enough thyroid secretion (as there is not in the cretin) the transforma-

tion does not take place or takes place only incompletely. We have consequently in the nose a landmark that furnishes some indication as to what the thyroid was doing in the individual under examination during a particular age period. Accordingly it has been suggested by Keith that the difference in nasal appearance of Mongols and Caucasians is due to relatively less thyroid secretion in the former.

It has always been recognized that the teeth have a determining effect upon the general expression of the face, and in particular upon the profile. They without doubt influence the contribution to the face made by the upper and lower lips, apart, of course, from what these contribute independently. As important decorative features of the face, too, the teeth demand attention. The teeth represent a curious amalgamation of skin and bone. Each tooth might be looked upon as a peg of bone variously shaped and sheathed in a wall of lime scales, known as enamel, which is really its skin, to protect it against the injurious agencies of the outside world, and particularly against infected food. As each tooth has a particular position in the mouth, and has its own time of eruption, each tooth may be looked upon as a

landmark of the endocrine history of the individual.

The size of the teeth, their color, their quality, their position and shape regularities or irregularities on the surface, with other abnormalities, supply information concerning what has gone on as well as what is going on among the glands of internal secretion. The degree of calcification—that is, the degree of impregnation with lime salts—determines, other things being equal, two notable properties of teeth, color and resistance to decay.

Thus the teeth of individuals in whom the thymus gland seems dominant have an infantile milky-white appearance, are translucent, and often, because of their poor mechanical resisting power, are scalloped or crescentic at the grinding edge. The next stage of calcification is represented by the teeth of the thyroid dominant individual, which are even and of a grayish-white color with a brilliant sheen. Pituitary-centered people possess teeth that are too large or too small for the mouth, markedly separated or markedly crowded, peg-like, often with prominence of the middle incisors. Persons with sex-gland difficulties may show them in distorted or undersized lat-

eral incisors. Why this should be is difficult to imagine. It has been suggested that the explanation may have something to do with the fact that in certain invertebrates the sex-glands are in the mouth.

The most highly calcified teeth are those of the adrenal-gland-centered types, which are most resistant to injury. It has been observed that men and women with such teeth, and also presenting other stigmata of an adrenal-gland-centered personality, also have canine or fang teeth that are long and sharply pointed. On the other hand, in individuals with congenitally poor adrenal gland function, these canine teeth may not be fang-like or pointed at all, but are flattened and remind one of the incisor teeth and might in fact be called the third incisors. Since pugnacity is a well-marked personality trait of adrenal-gland-efficient people, while timidity accompanies adrenal-gland-poor states, we have an interesting example of correlation of gland activity and the form and function of organs. Another interesting fact is that the bellicose carnivora have strikingly well-developed fang-teeth, while the more pacific insectivora have canine teeth that are not pointed at all but have been described as the third incisors. Some people

then, on the basis of their teeth, become classifiable as of a carnivorous temperament, others as of an insectivorous temperament. That does not, by any means, provide for inevitable groupings; the natural carnivore may become a fighting vegetarian, the natural insectivore may, by compensation reactions necessary when the subconscious compromises with civilization, become a rabid militarist or pacifist. But a study of the inner life and natural tastes and reactions of these people will yield the actualities of their make-up.

Though a face cannot really be looked upon as, say, an automobile is looked upon, as an assemblage of parts, there are certain characteristics which have often been observed as running together. Styles or types of faces undoubtedly occur because we recognize the frequency of certain combinations of traits. There are also various diseases with distorted functions of the glands of internal secretion, in which it was found that there was an exaggeration of the type characteristics. This suggested a convenient means for classifying and studying faces, which was particularly interesting since the information obtained from studying the face provided valuable insight into the glandular mechanics of the individual's make-up.

The different constituents of the face—skin,

muscle, fat, and bone—are variously influenced by excessive function or insufficient secretion of the specific glands. The face of the individual in whom the thyroid is over-secreting physiologically contrasts startlingly with that of the man or woman in whom the thyroid is deficient. They represent, in fact, opposite poles of appearance. The same is true of overaction and underaction of the pituitary gland, of overaction and underaction of the sex-glands. The prefix "hyper" placed before the gland name is used to indicate more than average or standard secretion, such as hyperthyroid or hyperpituitary or hyperadrenal. On the other hand, the prefix "sub" placed before the gland name is used to indicate insufficiency or defect. Thus we may have the subthyroid, the subpituitary, the subovarian individual. The prefix "hypo" has been used frequently instead of "sub." The latter is preferable because "hyper" and "hypo" resemble one another and may easily be confused both in speech and print.

Let us take first the type of face most easily recognized as determined by endocrine influence, the hyperpituitary. This is characterized by an enlargement of all its parts, so that the whole face strikes one as being heavier than the average.

In the classical examples, there is little or no fat on the face. The forehead, the eyebrow ridges, the nose, the jaws, and especially the chin arrest the attention because of their size. Popular physiognomy has it that the large, prominent chin means determination and persistence. That may, or may not be true, depending upon the forces that have caused overaction of the pituitary, and upon the reaction that the other glands and the involuntary nervous system have shown. It has been my observation that in physiological hyperpituitarism, at any rate, character stability and integrity are personality traits. The cranium itself may be much larger than the average, and the portion of it known as the external occipital protuberance may jut as a pronounced bump. Another characteristic is the separation of the teeth, definite spaces being visible between them. Lips are fleshy or thick, and so is the tongue. The large, oblong, bony, square-jawed face should always suggest the hyperpituitary individual.

The subpituitary face is antonymic to the hyperpituitary in its composition. Instead of being long and angular, it tends to be rounded and reminds one of the man in the moon. Instead of the strong man's chin, there is a tendency to suppression of it as well as of the cheek-bones and

other bony parts by fat. The nose, instead of being large and well developed, is smaller, flatter, spreads more at the sides, and may be pointed. And instead of the sharp, alert, aggressive, or even irritable expression of the hyperpituitary, there is a calmness and peacefulness, or a jolly self-complacence, or a dullness which may indicate real stupidity or lethargy. Whether it is one or the other may depend upon what the thyroid gland is doing. If it is stimulated to compensate greatly for the deficiency of pituitary, we have the subpituitary hyperthyroid type who is stout and squat, but keen, alive, and humorous. If the thyroid fails to compensate, we have the short, fat, lazy, sleepy moron.

Characteristically, the hyperthyroid type provides the accepted and admired group of melodrama and cinema heroes and heroines, sheiks and vampires. Tall, handsome, slender, regular-featured, these are the adjectives the gushing critic applies in describing them. The face is oval in shape, delicately modeled; the forehead is high and wide, which contributes an effect of nobility; the eyes are large and brilliant and may bulge—described familiarly as pop-eyed; the nose and ears and chin form a harmonious ensemble

that confers upon it an undeniable charm. Why is one of the mysteries of esthetics.

The subthyroid face resembles the subpituitary face in the quality of roundness and substantiality. But there is a difference, and a difference perceptible to any close observer. For the face of the subthyroid individual gives the effect of being thickened by an infiltration, a solidification of the skin, which is in fact true. The skin looks and is thicker than the normal, so that it will not yield or dent when a finger is pressed into it. It is dry and resistant. This, together with the lowered and slowed mental activity, contributes to the picture of stolidity and indifference. On the other hand, the subpituitary face is large and really fat because of the increased amount of fat laid down in the fatty layers of the skin, which is moist and soft.

The expression of the subpituitary face is in consequence distinctly a contrast to that of the subthyroid in that it looks more alive to the outer world. There is, too, a difference often between the two types in the distribution of fat elsewhere in the body. In the subpituitary there are certain points of predilection for the deposit of fat besides the face; i. e., about the breasts, the abdomen, the

hips and thighs. The extremities, particularly the hands and feet, will show the least colonization by fat. As these are frequently underdeveloped from the bony standpoint, they stand out as ludicrously small when compared with the massive appearance of the rest of the body. The mountainous creature waddles upon stilts. The subthyroid people, however, have their thickening more equitably distributed. The hands and feet are as pudgy as the face. The eyes seem to be buried in their sockets because of the infiltration of the upper and lower lids, which droop as with weight. Nose, cheeks, and lips may have a peculiar sallow alabaster color. Above the collarbones there may be masses which suggest fat but are really collections of the same material which permeates the skin and causes the remarkable changes of its consistency.

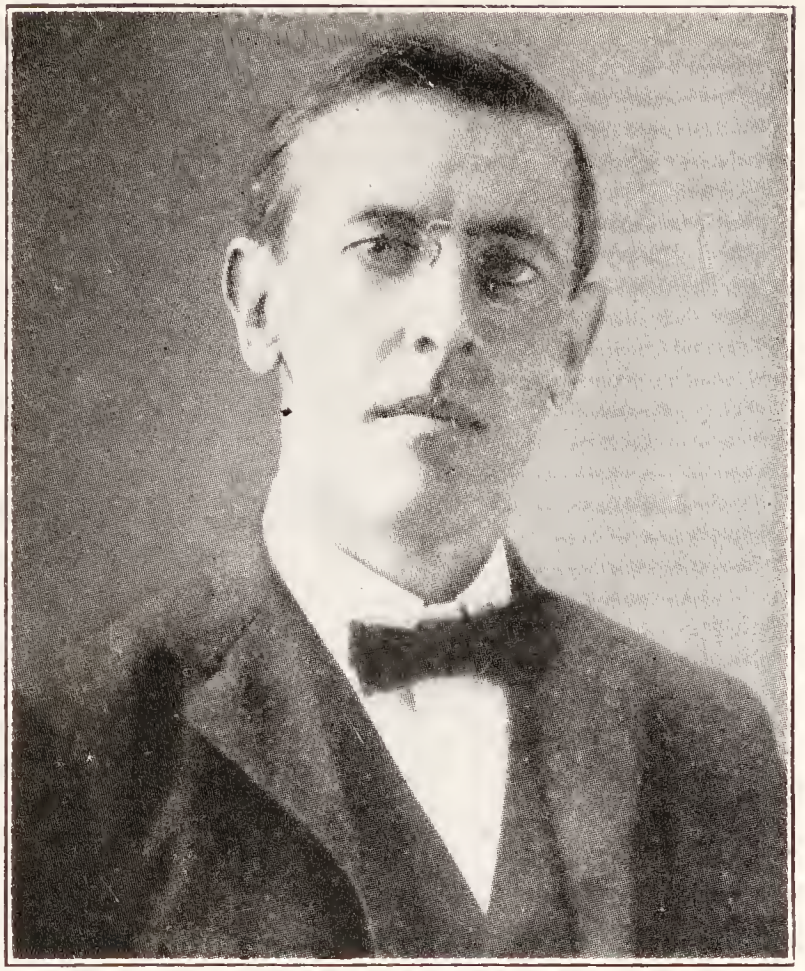
The faces of adrenal-centered individuals are more or less characteristic. They tend to be irregularly squarish or pentagonal in outline. The shape of the head tends to be round, and the color of the skin is generally definitely pigmented or freckled. A swarthy, hairy, rather squat face is one's primary impression. The hairiness of it is striking. The hair-line is low and makes its possessor a lowbrow; the eyebrows tend to meet

over the nose, creating what is called the nasal brow. The beard reaches well down on the neck and up over the cheek-bones, sometimes to the eyes. In older individuals, when the influence of the adrenal cortex increases in the constitution, the growth of hair in the ear-canals as well as on the ears themselves and on the nose is characteristic. At the same time there may be an increase of blood-pressure. In certain cases of high blood-pressure, a hypertrophy, probably accompanied by an increased activity, of the adrenal cortex, has been demonstrated.

When the adrenal glands become insufficient or weakened, or fail altogether, as occurs in Addison's disease, the face becomes thin while its pigmentation increases. This darkening of the skin may reach a degree which reminds one of the natural color of the skin of the American Indian, a bronzing, then, of the skin. Or it may in its worst forms attain a degree of black pigment deposit which suggests the coloring of the Hindu or even of the lighter negroes. The increase of pigmentation occurs earliest in the skin of the eyelids and reaches its greatest development. Patches of pigmentation may appear on the lips and upon the mucous surface of the interior of the mouth. The skin, thin and translucent, loses its tone and

relaxes in folds. The eyes are sunken and contribute to the ensemble an expression of sadness and melancholy which reflects the feelings of the sufferer. A great many people of this type exist in our cities who suffer from that "always tired feeling," who present those fleeting changes of pigmentation in the eyelids that are familiarly called rings under the eyes, and who besides exhibit a low blood-pressure and a low sugar-content of the blood.

The hairy face of adrenal-centered people represents one extreme when compared with the types of hairless faces, each of which is an effect of the dominance in the make-up of some particular gland. There is first the hairless face of the normal woman. This is dependent upon the action of the ovary. The internal secretion of the ovary inhibits the development of hair on the face, just as the internal secretion of the adrenal cortex (also known as the interrenal gland) definitely stimulates the development of hair on the face. After the menopause, when the ovary passes from the scene in the endocrine drama of the woman's life, more or less hair may appear upon the lip, the chin, or the cheeks. Among males, there are two types of hairless faces, those of the eunuchoid class, gonad-centered individuals who have in-



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Showing the facial characteristics of a pituitary-centered type in early manhood

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Showing the exaggeration of the same facial characteristics with advancing age

WOODROW WILSON

sufficient or no internal secretion of the sex-glands, and the thymus-centered group, in whom there is an excessive and dominating influence of the thymus gland, often associated with a deficient development and functioning of both the adrenal and sex glands. It is probably the defective adrenal and sex glands that are responsible for the hairlessness of these types. There is, however, a great difference between the eunuchoid face and the thymic face, and we can only infer that the thymus has a great deal to do with that difference.

The eunuchoid face, so called because of its resemblance to the appearance of eunuchs, a physiognomy with characteristics known for thousands of years, might be described with two adjectives, "old" and "fat." The old-fat skin, the old-fat eyelids, the paunchy cheeks, the wrinkled sallow effect that one associates with old age, may all be seen in a young man in his late teens or early twenties. There is usually much hair on the head, for these people, if they would permit their hair to grow, could acquire enough of a growth to permit an imitation of Godiva. Baldness is quite rare and indeed is almost unknown among them.

In contrast the thymic face reminds one not of an old man but of his antipode, a baby. The skin,

hairless, delicate in texture, smooth and soft, with its opaque-white or peaches-and-cream coloring, is irresistibly reminiscent of the infantile. The features are, in the typical variety, finely modeled. Altogether the type of face arouses admiration and elicits the label of "very handsome." Upon close inspection, however, even at its best, there is perceived a feminine quality, a contribution which detracts much from the total effect when compared with the sharp virility of certain kinds of masculine, pituitary-thyroid-centered faces.

There is another type of face which is called the Mongoloid face. The name speaks for itself. It is a face in a person of the so-called white, Caucasian, or leukodermic race which reminds one of the Mongol race, the Chinese or Japanese. Although it is primarily the cast of the eyes, the inward-downward slant of them, that provides the startling resemblance to another race, there are other features, such as the depressed root of the nose and the funnel-shaped mouth, which are just as reminiscent of the Asiatic. There is, besides, in the typical cases, a marked grade of mental deficiency which may amount to actual idiocy. Mongolism or mongoloid idiocy, as the condition is known in chldren when it occurs in its most fluid

form, is often confused with cretinism. It is, however, quite distinct from cretinism. Whether or no it is entirely a glandular disturbance is a mooted question. But the response to glandular feeding at the hands of such observers as the Englishman Crookshank and the Frenchman Apert is strong evidence in favor of that view, as is also the fact of the remarkable transformations in these peoples that sometimes occur at puberty. There are all grades of Mongolism in any population.

If the different general characteristics of the types described in the preceding paragraphs are listed, there results a series of standards for the comparison, grouping, and classification of various individuals. But besides the general features, there are details to be considered in the construction of any particular individual, such as the quality and texture of the hair as well as its distribution, the nails, the skin, the voice and gestures, even the manner of walking or gait. All of these must be regarded as an expression of the personal equation and as throwing light upon its mysteries.

It is possible to regard the individual under consideration as a work of art and so to compare him with art objects. Inspecting any of the products

of an artist, one obtains first an impression of an abstract design which supplies the bare outline or plan of work. After the design comes the perception of detail which is added, superimposed, or perhaps one should say grows into, fills, and completes the underlying framework.

The varieties of facial build and appearance I have described in relation to the different glands of internal secretion may be looked upon as various designs of the internal creative forces. The facial decorations, the special quality, coloring, and texture of skin, the placing of the hair, and the character and arrangement of the ears, nose, and so on are the expression of two sets of forces. One consists of the specific nature and placing of the chemical units, the genes of the chromosomes, in the original cell out of which the individual has developed. The other set includes all those complex and remarkable chemical reactions which are either set going or controlled and regulated by the glands of internal secretion. It is a fact which provokes awe as well as inspiration to realize that the shape of a hand, like the shape of a soul, may be determined by the activities of atoms and molecules whirling about in a little gland at the base of the brain.

CHAPTER VIII

SEX AND SEX-LINKED CHARACTERS

IT has long been known that the removal of the sex-glands, the castration, of a young animal will interfere with the development of the reproductive organs, as well as with the full development of those distinctive attributes which are described by the words "masculinity" and "femininity." From the earliest times the experiment was carried out by breeders upon their domesticated animals, as well as upon human beings. Eunuchs appear in the records of the oldest empires of the East. The effect of absence of the sex-glands upon the personal mental and physical traits has its characteristic expressions in every language.

Though the medieval theory of temperaments, of a mixing of humors or juices, of blood and bile and lymph, in different proportions, as determining personality, was popular for some centuries, there was never included in it a chemical influence from the sex-glands. Not until Bordeu published

his book on "Analysis of the Blood" was there a formal attempt to correlate a chemical contribution to the blood from the sex-glands with the various traits of character. And not until Berthold carried out experiments on fowls in which he transplanted the sex-glands from their natural site to the abdomen and found that there was no alteration of the specific sex traits of structure and function, was there complete proof of the existence of a sex chemical.

Since then thousands of researches have been carried out, to elucidate the mystery of sex and its problems. As their fruit we are in possession of certain facts. First, as with every other trait of the individual, the development of sex is dependent upon the presence in the fertilized egg of certain substances or materials. It happens that this substance or collection of substances in the case of sex is so large as to form a complete chromosome (a chromosome being one of the pieces into which the nuclear material of a cell breaks when it is getting ready to divide and make two cells out of itself), or even two chromosomes, known as the X and Y chromosomes. These are present only in the fertilizing male or sperm cell, but not in the female fertilized

cell or ovum. The sex chromosome is sometimes known also as the odd chromosome. Because the number of chromosomes in the maleness-conferring germ-cell is less than the number in the femaleness-conferring germ-cell. Femaleness and maleness are primarily the effects of presence or absence in the fertilized ovum of specific chemical materials.

Mr. X then is a Mr. X, and not a Mrs. X or a Miss X because he started out in life lacking certain chemicals. When he was a fertilized ovum, about one four-hundredth of an inch in height, and about the same in breadth—that is to say, when he began existence—there would have been only one way to tell what he probably was to become, boy or girl, man or woman. That way would have been to have placed him in some pickling fluid for a time and then to stain him with dyes and count his chromosomes. Manifestly, with that enlightenment obtained, his career would be ended there and then.

Every species of creature has a fixed number of chromosomes to its cells. But the number of chromosomes is different for male and female. In human beings, for instance, in the cells of all the organs and tissues, of the liver and spleen,

the kidneys and heart, the chromosome number is 24 for the female and 20 for the male. The female has more than the male.

How does this come about? When the germ-cell, male or female, divides in the course of preparing itself to be a full-fledged, graduated, mature reproducer of the species, it loses one half of its chromosomes. This it must do to make it fit to mix with a germ-cell of the opposite sex, in order not to upset the scheme of things. For if it has, say, 20 chromosomes and the other cell contributes 24 chromosomes, the result would be 44 chromosomes. If now in the reproduction of a latter generation, a cell containing 44 chromosomes meets a cell containing 44 chromosomes, we have 88 chromosomes. Endless confusion would be the consequence. Nature is a conservative, and to maintain the stability of the species she makes use of the simple device of halving the number of chromosomes. When the germ-cells unite, the natural species number is reformed, and all 's well that ends well.

It is important to understand clearly the rôle of the X or sex chromosome because it provides a perfectly definite case of the manner in which nature works in producing traits in individuals by means of the presence or absence of specific sub-

stances in cells. When the sperm-cells, the reproductive cells of the male, lose one half of their chromosomes to make them fit for reproduction, an *even* number of chromosomes should result. After this process of reduction to one half of the number of chromosomes, it is seen that certain of the sperm-cells have an uneven number of chromosomes because of the fact that there is an extra one which behaves independently of the others. As a result, there are two kinds of male reproductive sex cells, one kind containing this X chromosome and the other without it. Following now what happens when these two different types of male sex-cells fertilize the female sex-cell or ovum, it was observed that eggs fertilized by sperm containing the mysterious stranger, the X chromosome, always develop into males. Even before there is any visible evidence of sex in the embryo, therefore, its future sex can be distinguished by counting the chromosomes of its cells. For every cell which develops out of the original fertilized cell will contain the same number of chromosomes.

To sum up, femaleness appears to be maleness plus, or maleness may be considered femaleness minus. This plus or minus is not to be taken in any simple sense, because it signifies a whole se-

ries of events which cause the divergence of male and female. But they emphasize the fact that maleness and femaleness are conditions of development from a common soil, and are therefore capable of all degrees of closeness of relationship.

Now, it should be stressed that this simplicity of conception of what sex means and how it is determined holds good only for the lower creatures in whom the male is the fertilizing element and the female the fertilizable element. To be sure, there are other qualities which distinguish the male from the female. Among butterflies, for instance, the male is the more brightly colored and decorated. If the sex-glands or reproductive organs are cut out, or injured by disease, the other sex qualities develop just the same, without reference to that fact. Among the vertebrates, however, the qualities of ornamentation and behavior which we designate as masculine or feminine, which Charles Darwin portrayed so assiduously in his "Descent of Man," and for which he coined the term "secondary sex characteristics," become intimately connected with the sex or reproductive organs or glands themselves, so that injury or disease of them interferes not only with the reproductive capacity of the individual but also with the proper expression and functioning of those

qualities which we describe as the masculine or feminine. Since these qualities appear directly linked with the normal chemistry of the sex-cells, it is most convenient to speak of them as "sex-linked characters."

The existence of these "sex-linked characters" brings a complication into our ideas about the sexes and about what constitutes masculinity and femininity. When our criteria of sex are merely the production of male fertilizing elements or female fertilizable elements, the distinction between the sexes is sharp, and classification easy. But when we come to consider the sex-linked characters or traits, we find very often curious contradictions, exceptions, and situations, particularly among men and women. We may find, for example, an individual who is a man so far as the reproductive organs are concerned, but who reminds us of a woman in figure, the texture of skin, the locality and quality of development of hair, the voice, the manner of walking, the general behavior. There is of course the expression "effeminate man." Conversely there is the person who is legally and socially a woman, but who presents characteristics of build, action, and psychology that remind one of a man. The term "virago" was coined to express the contrast be-

tween the accepted feminine and the Amazon.

These deviations from the so-called normal masculine and feminine are the extreme types. In examining any series of men and women picked at random, one will find a great many who will exhibit signs of underdevelopment of one or another of the qualities peculiar to their sex, or a certain degree, sometimes a remarkable degree, of development of a quality or qualities considered as belonging to the other sex. In other words, the masculine and the feminine are not absolute because all sorts of *transitions* between them occur. These intersexual forms, or sex intergrades or intermediates, are of the utmost significance in enabling us to understand many puzzling problems and abnormalities of the personal equation.

Woman, during her mature sex life, undergoes a cycle or rhythm of changes in the sex apparatus which is reflected in her nervous system and in her mentality. Menstruation and the menstrual cycle are the consequences of chemical rhythms which have their origin in a chemical substance produced periodically in the ovary as an internal secretion. Recently, by means of this substance, very young sexually immature animals have been made sexually susceptible and have presented various phenomena strictly comparable to menstru-

ation. Its separation fully confirms a host of data which had previously indicated that the ovary was a gland of internal secretion regulating the development of feminine traits and controlling their functioning.

Adolescence, maturity, decadence, the three epochs of woman's life which correspond to institution of menstruation, regular recurrence of menstruation, and finally cessation of menstruation—change of life or menopause—may be said to depend absolutely and completely upon the elaboration of a chemical by the ovary as a gland of internal secretion. This substance, though not yet isolated in pure form, is now available for therapeutic and modifying administration. Naturally a number of conditions of light, heat, food, suggestion, as well as the action of the products of the other glands of internal secretion, may influence the chemical reactions by which this substance is generated, as well as the chemical reactions in which it takes part. But it is fundamental, essential, crucial to femininity. Without it nothing happens, nothing can happen of the perturbations of puberty, the disturbances of love, or the distresses of decadence.

A corresponding substance, with similar effects upon the history of sex in the male, is produced

by special secretory cells of the male sex-gland or gonad. These cells are also known as the interstitial cells, and as a collection have been described as the interstitial gland. It has never been isolated in pure form, but extracts containing it, and exhibiting powers that it alone could manifest, have been used to demonstrate its reality and functions. It is fundamental to the initiation of puberty in the growing boy, and to the maintenance of sex function in maturity. It also stimulates the production of those external characteristics of appearance, manner, and behavior which distinguish the masculine from the feminine. Its secretion, like that of the ovary, seems to occur in waves, rhythms, or cycles, but without the production of the gross striking phenomena of menstruation. It has been shown that there is a monthly variation in weight of men, accompanied by a variation of the body chemistry, expressing itself in a periodic increase of the phosphorus lost from the blood through the kidneys. A corresponding psychic variation concomitant with an increased sex irritability and susceptibility have been observed, and also a periodicity about the expressions of what is going on in the internal economy in erotic dreams. Moreover, menstrua-

tion of a curious sort has been reported as a rarity happening in certain men.

Nor is the so-called change of life a monopoly of women. There is a similar but by no means as dramatic a transformation in man. While the age period in women is a fairly constant one, being somewhere in the middle forties, it may in men occur, and generally does occur, as a slow gradual deterioration of the sex reactions somewhere between the middle fifties and the middle sixties. In this process there has to be considered another gland of internal secretion, the prostate. It is the most important of the organs accessory to the sex-glands in the male. Its secretion has been shown to have effects upon developing organisms comparable to those of thyroid, but without the poisoning effects which large doses of thyroid produce. Furthermore, study of its cells under the microscope has demonstrated cyclic monthly changes, which are additional evidence of the existence of a sex rhythm in the male as well as in the female, in some way related to the phases of the moon. Its external secretion is necessary to the vitality of the moving reproductive male cells, and without it effective penetration and fertilization of the ovum are impossible. The atrophy of

the prostate gland is perhaps the determining event of the masculine sex decadence. As it shrinks, echoes and reverberations of the event sound through the personality, evoking sometimes a melancholia, a suicidal despondency, a neurasthenic irritability, or sometimes promoting a sex mania, which leads to delinquencies of behavior and errors of judgment which may ruin a man socially and financially who has all his life been a respectable pillar of society.

What is the normal in sex cannot, therefore, be easily defined. An individual apparently normal to all outward appearances may be carrying the germs of developing abnormality which may land him in disaster and destruction. Theoretically a normal individual should have the primary reproductive organs fully developed and possessing reproductive capacity. He should also have the secondary or sex-linked traits, the hair, the masculine skin and muscle, the masculine shape or body contour, the masculine voice, the masculine attitude. The normal female has the skin and hair, figure and voice, which we all measure with a glance as feminine. Yet when we consider the cases of the men and women we know, how many of them may be said to have all the standard or ideal male sex traits and so be entitled to a rat-

ing of 100 per cent masculinity or 100 per cent femininity? Most people are lacking or deficient in one or more of the sex peculiarities. It is, therefore, possible to conceive of a sex index, a figure stating the percentage of masculinity and femininity, based upon the average of the values present of each sex trait, as compared with the ideal development. Upon such consideration there may be built, and there undoubtedly will be, a scale for the placing of any particular individual from the sexual glandular point of view.

Even from the psychologic side we see all sorts of transitions between the masculine and the feminine, and contradictions between the structural make-up, which speaks strongly for a definite masculinity or femininity, and the mental reactions which belong to their opposite, although in the great majority of cases a fair parallelism is preserved. When the sex traits of the body are marked, those of the mind are marked, and when there are evidences of variation toward the other sex, the effect is manifest mentally as well as physically. Yet there are numerous people who present mental manifestations that contradict the physical appearance. They are problems which can be understood only when we take into consideration the principle that all of the glands of in-

ternal secretion, the pituitary, the pineal, the thyroid, the thymus, and the adrenals, as well as the sex-glands or gonads, influence the development of the secondary or sex-linked characters, including the mental as well as the physical. A disturbance of function of one of these glands, not great enough to influence the others, might cause an underdevelopment or overdevelopment of some of the sex traits without affecting others.

This conception is the only one which enables us to understand the occurrence of sex intermediates of various types, as well as the fact that individuals occur very occasionally who possess so many of the external features of one sex as to pass all their lives as typical normal members of that sex, and who yet have in addition the reproductive organs of the opposite sex, without having the *sex-glands that they ought to have had.* Neugebauer reported thirteen cases of people who passed all their lives as males and lived as males but who, after death, were found not to have male sex-glands at all and, most astonishing of all, had ovaries and a womb. What they did have were adrenal glands five times as large as the normal. The tremendous impulse toward masculinity conferred by the adrenal glands is emphasized by these cases.

The psychologic differences between men and women are many, and have been made the subject of a number of studies. There are certain associations of sex feeling which may be classed among the sex-linked characters, and which are often seen in an exaggerated form as the consequence of glandular disturbances. One is sadism, which is excitation of sex feeling by the infliction of pain. The other is masochism, which is the stimulation of sex feeling by the endurance of pain. In its most rudimentary form, the sadist feeling reflects the normal masculine domination of the female sexually. And, to a minimum extent, the masochist feeling is part of the normal feminine sex reactions. When we see traces of the masochist tendency in men, a hankering for the pleasure of pain, or sadist leanings in women, a craving for domination and the assumption of the masculine attitude, it is worth looking for other evidences of perversion of one of the sex-controlling glands such as the adrenals.

Out of the conception that femaleness is maleness plus, modern thinking is drawing the most interesting deductions. One is the idea already emphasized that the two sexes are not at all to be looked at as absolute, unalterable, antagonistic entities. They are by no means two species, as the

writers on the Duel of the Sexes would have us believe. In particular is the feminine a complex of characters that may and often do become masculine. Authentic examples are known among birds, quadrupeds, and humans of individuals who have been mature females, have functioned as such, and have reproduced and raised young, and who have then changed into males, with the body characteristics of males and behaving as males. Crew reported a case of a hen which was egg-laying until three and a half years of age and which then was transmuted into a cock by a series of moltings. There was formed the rooster's comb, wattles, and plumage. With the ultimate attainment of the complete powers of a cock, a young hen was impregnated, from whose eggs chicks were raised. Recently Riddle has described a similar instance of transformation of female into male. At the bottom of these changes have been discovered transformations of ovary tissue into testis tissue. Such composite sex-glands, sex-glands composed of both male and female elements, with the female elements disappearing and the male elements increasing, are being reported with greater frequency now that they are being sharply looked for, in dogs and goats, pigs and moles and women. That is to say, the

female, being male plus, may by losing the plus become an actual male.

At any rate the appearance of masculine features, such as a growth of hair on the face, a change of voice that deepens and strengthens it, a change even of intellect from the feminine to the masculine type, has been noted by every one in women after the so-called change of life, when the ovary ceases to produce its internal secretion. A more profound push toward the masculine occurs in young women when there is hypertrophy or overaction of the adrenal cortex. They may then cease to menstruate, grow a full beard, and show a behavior psychologically and sexually which sometimes becomes a definite and conscious homosexuality.

In some of these cases, the enlargement of the adrenal glands has been great enough to constitute a tumor calling for surgical removal. After a successful operation, menstruation has returned, and the beard and other superfluous hair have been lost.

If adrenal gland substance is fed to tadpoles (which usually develop into male and female frogs in about equal numbers) they nearly all develop into males. In this connection, it is interesting to note that throughout life the adrenal

glands are larger and heavier in the male than in the female.

Maleness and femaleness are best understood, in the light of our present knowledge, as the expression of chemical influences stimulating or depressing the evolution of the various characters we recognize as belonging to the sexes. One may then logically expect all sorts of combinations of sex characters to occur, which as a matter of fact do occur, and are roughly included in the term "sex intermediates." One may also understand how at one period of an individual's life his chemistry will be feminine, and how, at another, his chemistry will be masculine. And when it comes to the subtle influence of the sex secretions, including those of the prostate, upon the nervous system, sensitive to the slightest changes in the blood, we can imagine a change from a feminine to a masculine chemistry in the course of twenty-four hours.

The problem of homosexuality has had light thrown upon it by study of the internal secretions. Among certain peoples homosexuality has been regarded as a normal expression of sex. The Greeks of the Age of Pericles, for instance, had no objection to the practice. Among the Hebrews, contrariwise, it was a vicious sin, and was con-

demned as of the doings of Sodom and Gomorrah. There can be no doubt that biologically homosexuality is an abnormality, and a pathologic abnormality, because it is not an aid to reproduction in any sense of the word and runs counter to the principles of the normal sex life that may be deduced from anatomy and physiology.

For a long time, homosexuality was considered scientifically, if not a vice, at least a result of mental aberration, inherited or acquired—in plain English, a bad habit. Certainly there are homosexuals who might more properly be called pseudo-homosexuals, the products of suggestion, or education, or of a lack of opportunity for companionship with the other sex. Among animals and men, segregation of males or females for a long period will cause a percentage to take to homosexuality. These may be accurately spoken of as psychic in their origin and must be attacked therapeutically from the psychic viewpoint.

True homosexuality, however, the sexual attraction to members of the same sex regardless of environment or sex opportunity, may be best interpreted as a glandular matter, as the effect of a relation between the glands which makes for the production of an intersexual state, or for a min-

gling of some of the characteristics of either sex. The resulting individual might be labeled a "functional hermaprodite."

Until recently only clinical cases of intersexuality and the functional hermaphrodite were available for analysis in terms of the glands of internal secretion, and much of their interpretation depended upon inference. Inference is as good a way of getting at the truth as direct demonstration but never quite so convincing. When Pezard Sand and Coridroint reported that they had succeeded by various gland transplantations in producing roosters who had the female plumage in combination with the male comb and crow, male instincts, and the ability to fertilize the female, the greatest interest was aroused. They have even been able to produce modifications of the body on one side alone. To the objections often raised against the theory of a domination of personal characteristics by the endocrine glands, that a substance circulating in the blood must affect equally symmetrical parts of the body whereas various abnormalities affect only one half or one quarter of the body, these experiments are an effective reply.

A study of the sex intermediates' bodily proportions has shown that not only are they psy-

chically intermediate between the two sexes but also physically. There are the figures of A. Weil, who measured a number of individuals, normal and abnormal, with whose sex psychology he was thoroughly conversant. Among them were two hundred male homosexuals. He also examined a number of virile women. He found in about 95 per cent of his cases a deviation toward the proportions of the opposite sex. Most strikingly these are exhibited in the relation of shoulder width to the width between the hips. In normal men the shoulder width is broader than the hip width. Among his male homosexuals, Weil found that the shoulder-hip proportion approximated that present in normal women. Among homosexual women, the reverse is true; the body measurements approach those of a man more than those of a woman. The data in the case of these masculoid women may be worth quoting as they illustrate the point most definitely.

		Normal woman	Normal man
Height	162.1 cm.	154. cm.	167. cm.
Upper skeleton length	79.3 cm.	79. cm.	85. cm.
Lower skeleton length	82.8 cm.	75. cm.	82. cm.
Shoulder width	36.1 cm.	35. cm.	39.3 cm.
Hip width	32.8 cm.	34. cm.	31.8 cm.

"Masculoid" is the word suggested to describe these members of the intermediate sex.

The problems of the intermediate sex are very real and sometimes terrifying to its members, strange, bizarre, or even "queer" as they may seem to the comfortably normal. They are at constant war with themselves and in continuous conflict with the standards and statutes of society. And, besides, they have curious submerged traditions to contend with, the traditions and influences of those in the know. In Europe I have been told there is a legend among the class to the effect that all the great men of history, the great statesmen and thinkers, the brilliant composers and poets, kings and queens of genius, have all been homosexuals. It is whispered that this famous living man or that distinguished living woman is a member of the class. The legend attempts to drag William Shakspere and Michelangelo in its wake.

I shall relate the stories of two women, with definite signs of glandular disturbances at the bottom of their misfortunes and sufferings, whom I have had occasion to see in my office. One was a young woman of about thirty-five who brought with her a good-looking young woman of about eighteen. Let us call the older woman Miss A and the younger Miss B. Miss A proceeded

to state that she was head over heels in love with Miss B, with a love that was completely reciprocated, a fact of which Miss B hastened to assure me in the most positive terms. They came to me because they wished to be married legally, and felt that the true bar to the consummation of an alliance was the circumstance that the law never saw beyond its nose. If I would examine Miss A, and find her a member of the intermediate sex and sufficiently masculoid to be classed as masculine for all practical purposes, would I not issue a certificate stating my findings and conclusions, which would enable them to convince some country justice of the peace. They came, by the way, from a small town in New Jersey, several miles from New York.

I hastened to explain that as I read present-day law and custom, such a procedure was absolutely impossible and out of the question. Miss A then changed her tactics and declared that all she wished to know was how much she actually deviated from normal femininity, and to get an outsider's angle on the whole matter. It appeared that she was the manager of a large department-store and that Miss B was one of her employees. Miss B seemed wholly feminine, although no complete examination was made of her. But she ad-

mitted quite frankly that she was attracted by the masculine qualities of Miss A.

Miss A came of what was apparently a quite normal family. Her father had been an average-sized man, sallow, freckled, and sandy-haired, as she was, and had lived quite happily for over thirty years with his wife, who was still alive, a thin, wiry, nervous, and very fair-skinned woman of sixty-eight. Miss A herself had had no difficulty or delay in learning to walk and talk or in her development in general until about her seventh year, when she had a very severe attack of scarlet fever. She then began to go to school, where she did poorly in mathematics and free-hand drawing, and discovered she had little or no sense of rhythm, finding it a long ordeal to learn even a little of dancing or skating.

At about twelve and a half she began to menstruate. There were no mental or physical difficulties associated with the onset. At first, the menstrual periods were quite regular. But then she proceeded to have a series of infections. At sixteen she had in direct succession chicken-pox, typhoid, and measles, which she had escaped in childhood. Whooping-cough in a most aggravated form came at twenty, and mumps at twenty-five. At thirty-two she was laid up for six weeks

with diphtheria followed by scarlet fever. This history of the so-called common diseases of childhood attacking after adolescence instead of before, as is usual, I have observed in a number of cases of homosexuality. In this case, they were particularly trying and malignant. It appears that the genital glands, the ovaries, exert after they have flowered a protective influence against infections, particularly epidemic infections. When the ovaries are not functioning properly, resistance against such infections is not present, and so, if the individual is exposed, they "take." When a succession of them occurs, as happened in the present case, the ovarian internal secretion, the efficiency of which was low to begin with, was lowered to such an extent that its influence in the organism is much diminished. One of the functions of the ovary is to inhibit the development of certain masculine characteristics. Loss or great diminution of its influence favors the expression of these same male traits. That was what the examination showed: masculine hair in places where masculine hair should not be, shoulders broader than the hips, dry coarse skin, and a blood-pressure higher than the normal. An X-ray of the head showed some excavation of the bony cradle of the pituitary gland. She was in-

formed of the existence of these stigmata of intersexuality and was told that in a sense she could be classed as a functional hermophrodite, a being who, though dominantly of one sex, possesses enough of the characteristics of the other sex to be grouped under the rubric of intersexuality. Scientifically and legally, however, she had to be classed as a woman, though she presented traits and tendencies of a variant deviating so far from the normal as to swing at times into masculine territory. She illustrates perfectly the life-history of the border-land sex types.

It is not only in private life that the various grades of the intermediate sex must be considered. They may play a rôle of even greater importance in public life. How often hysterical characters have been historical characters no historian has as yet given us the statistics. Yet it is obvious that the intermediate sex, because of its very abnormality, must come into the most direct conflict with custom, morality, and the accepted conceptions of the natural and the normal, with tragic results.

These facts, however, are but little appreciated in the study of historical characters. Even so self-consciously free and swankingly up-to-date a

contemporary as Bernard Shaw fails to make himself acquainted with available knowledge on the subject. In his recent chronicle play, "St. Joan," he pretends to supply the completest possible modern portrait and understanding of one of the most interesting characters of history. In the play and in its preface he has evidently been at pains to read everything he could lay his hands upon concerning her. But because of the fundamental wrongness of his viewpoint in the interpretation of the information available, he has got her all wrong. His attempt at diagnosis of her type cannot stand analysis. He says: "The most sceptical scientific reader may therefore accept as a flat fact, carrying no implication of unsoundness of mind, that Joan was what Francis Galton and other modern investigators of human faculty call a visualizer. She saw imaginary saints just as some other people see imaginary diagrams and landscapes with numbers dotted about them, and are thereby able to perform feats of memory and arithmetic impossible to non-visualizers. Visualizers will understand this at once. Non-visualizers who have never read Galton will be puzzled and incredulous. But a very little inquiry among their acquain-

tances will reveal to them that the mind's eye is more or less a magic lantern, and that the street is full of normally sane people who have hallucinations of all sorts which they believe to be part of the normal permanent equipment of all human beings."

As a matter of fact there is just as much ground for conceiving Joan as one auditorily imaginative, that is, one who thought in terms of sounds and of things heard. For she insisted as much upon the reality of the Voices she heard and the bells that rang in her ears and the messages she received from the saints as upon her visions. And that fact practically settles the question as to whether she really was a visualizer. Among psychologists who accept the classification of visualizer and auditor, it is the opinion that the two faculties are nearly always mutually exclusive. That is, a visualizer tends to think and act exclusively in terms of the seen; the auditor, in terms of things heard. But indeed the intensity of her visions and auditions was quite unlike those of the normal reverie, involving images or sounds. In Joan's case they had a quality of reality, a convincing force, that reminds one strongly of the experiences of the possessors of the "eidetist" faculty, which I have described in a previous

chapter in relation to the parathyroid glands. Among child eidetists their visions have a compelling and sometimes obsessive quality which may pursue them by day and give them terrors at night. More likely than not, if we can adduce that Joan was glandularly abnormal, such a view would receive valuable reinforcement.

Now, in fact, there is evidence of the most definite kind that Joan was glandularly abnormal. The most important physiological fact about Joan's history, a fact elicited and carefully gone into by the commission which investigated her before her trial and recorded in the official report published by Quicherat in 1841, entirely realistic documents, as Shaw himself says, is the fact that she never menstruated. This fact ought to occupy a central position in any analysis of the core of her personality. It, as the absence of the most important secondary sex feminine character, would imply the absence of other secondary feminine sex characters. It explains her craze for soldiering and the masculine life. It explains her obsessive craving for masculine clothes, upon which she insisted even when they were not necessary. She demanded them as emphatically in prison as upon the battle-field. It explains much about her ways and life to conceive her as a

member of the intermediate sex who, because of the peculiar circumstances in France at the time, was catapulted into the lime-light by the inherent tendencies of her masculoid nature.

The characteristics of her facial appearance which strike Shaw also favor the hypothesis of glandular abnormality. The high cheek-bones, with eyes wide apart, point to ovarian deficiency (which would go with the absence of menstruation), while the bulging eyes point to thyroid overactivity. All other things being equal, one would expect such an individual, freed of the urgencies of sex and driven by high-pressure energy production, to emerge as a prominent figure in any community of normals. When such a hyperthyroid eunuchoid is at the same time an eidetist, with a conception of the content of the world of reality so different from the normal, a character and biography like Joan's is almost inevitable. Shaw's besetting anti-medical prejudices make him ask the reader to choose between "the consecrated wafer . . . the very body of the virtue that was her salvation" and "a precise and convenient regulation of her health and her desires by a nicely calculated diet of thyroid extract, adrenalin, thymin, pituitrin and insulin." Thus he betrays an attitude parallel to that of the bishop

who attempted to wither Thomas Huxley by inquiring scornfully concerning his monkey grandfather in a debate on evolution. That St. Joan or St. Theresa or other outstanding figures of history, art, and science were characterized by various glandular abnormalities is no reflection upon them but serves for a more fundamental comprehension of their lives and influence. That abnormals have made the history of the normals is a generalization that makes worth while the investigation of all clues to the genesis and maintenance of abnormality.

CHAPTER IX

INTELLIGENCE AND TEMPERAMENT

THERE is a word which has more meanings attached to it and less accurate information than any other commonly used word in the language. This word is the word "soul." It is a word which is quite frequent in the mouths and writing of quasi-educated people as well as those fractionally but more or less completely educated. It is a word however, which seems to be becoming obsolete in scientific publications, and more particularly in the writings of the science which was once by definition supposed to be specially concerned with it, the science of psychology.

For this obsolescence there is a very good reason. The word has had a long and curious history, with progressive modifications of meaning during that history. No etymology or etymologist has furnished me with a universally accepted origin for the word. One cannot help suspecting some relation with the word "soil." The analogy is obvious. And, if true, the origi-

nal coinage of the word had in mind a very definite and yet rational conception—the soul as the soil of the self, out of which the manifestations of the self sprouted.

However, animistic doctrine, the doctrine which once pervaded all human thought and was universally accepted, appropriated the word and made of it something quite different. According to animistic doctrine, belief, dogma, religious teaching, or scientific theory, whichever you will, since they were one and the same at the epoch of man's mental history when priests and scientists were the same persons—the soul was a spirit, a species of ghost which inhabited the body, moved it to breathe, to move, to act in various ways good and bad, and yet to be independent—to depart at the time of death because itself was possessed of immortality. Indeed, the whole theory of immortality was based upon the existence of an essentially independent and fundamentally indestructible "soul."

This doctrine of a "soul" composed of "spirit," residing in and influencing, but opposed and superior to the body made of "matter," has persisted to our time. It is in fact the doctrine accepted as gospel truth by the hundreds of millions of the vast majority of mankind. Upon it

have been built numberless religions and ritual practices and a host of phenomena of black magic, occultism, and spiritism. The most honest and able believer in the doctrine was Thomas Aquinas, who is known in the Roman Catholic Church as St. Thomas Aquinas.

To a modern mind—that is, to a mind acquainted with the details of real knowledge concerning the relations of the body and mind available at the beginning of the second quarter of the twentieth century, and imbued with the intellectual integrity which created that knowledge—the doctrine is exploded. The logical case in its favor was never unassailable, was in fact a house of cards erected upon sand. What we know today of the relations of mind and body makes of them purely analytical concepts, conveniences of speech, as one distinguishes the inside of a house from the outside though the house itself is one, an organic unity of parts. It would be better, indeed, always to speak and think of body-mind or mind-body, except where one is specifically aware of considering different aspects of the same reality.

There are other contemporary usages of the word "soul." One is to have it refer to the emotional equipment of the individual. Another is

to have it connote the deepest part, the oldest part, the rock-bottom of the personality regarded as a system of layer upon layer of experiences. Another is to have it mean that ineffable, impalpable, inexpressible fragrance of the individuality which may convey the essence of a fragment of music or transmit an October moonlight to canvas. Still another is to have "soul" synonymous with "character."

There is one usage to which I believe the word may be legitimately and usefully put. In analyzing any individual it is possible to differentiate between what is called his intelligence and what is called his temperament. I do not wish to produce any technical definition of intelligence, since that is a matter about which even the psychologists, who are most concerned with it, are still debating among themselves. But for our purpose it may be described as the ability to bring knowledge and logic to bear upon a situation. As for temperament, the difficulty of definition is both greater and lesser. Lesser, as the professional psychologists have rather neglected the subject so that we need have no fears of treading upon the heels of acrimonious contemporary discussion. Greater because the word "temperament stands for that something of the personality

which it is most difficult to ensnare with the nets of intellect—feeling and the capacity for feeling, preponderating mood and outlook upon life and the world, a reflection of organic processes and an attitude toward life and the universe dependent upon them.

Now, pure intelligence as such and pure temperament as such do not exist. They are fictions, creations of the analytic needs of the intellect. Sometimes, as in the solution of a problem of mathematics, the lime-light upon the intelligence is so strong that the rest of the personality seems shadowy and non-existent. And sometimes, as in a suicide, because of uncontrollable melancholia, the intelligence seems far away and unreal as a mirage. But, as a matter of fact, they are always together, indissolubly linked. And as out of hydrogen and oxygen is compounded a new something with properties of its own; out of temperament and intelligence is compounded that something which awakens in the morning happy or unhappy, rises, dresses, moves about, meets people, makes decisions, registers experiences, reviews experiences, feels exultant or depressed, learns and forgets, exhibits qualities like sincerity, sensibility, conscience, and again goes to sleep. A name is needed for that

compound. The word "personality" will not do because a man's skin is also a part of his personality. Personality or individuality includes all of the components of body-mind or mind-body. But for the compound intelligence-temperament, the word "soul" is as good as any, because that is really what people mean when they use it without any definite reference to the animistic doctrines that were invented by the cavemen.

In the evolution of the individual the manifestations of temperament precede those of intelligence. Every mother recognizes that fact. After a few days, sometimes on the second day, the new-born babe exhibits qualities of temperament. Nurses in maternity hospitals speak of good babies and bad babies, babies who are easily satisfied and babies who can never be satisfied, babies who never cry and babies who always cry, with all the transitions between. But that is not because intelligence is not there, nor that it has not yet begun to function. As the weeks and days go by, and the occasions, the stimuli, for its development are adequately presented, the intelligence becomes manifest in association with the temperament, in its various degrees, running the gamut from the extremely bright to the dull, the feeble-minded, the imbecile, the idiot. But always

temperament is also there, present in various degrees, not however as readily classifiable and gradable as intelligence.

Now, from the point of view of modern thought, what is the physical basis of intelligence, and what is the physical basis of temperament? These questions are important not only from the standpoint of any general theory about life and the universe, but for very practical questions. For the answers to them, indeed the true tests of the answers to them, should involve a capacity to modify or change intelligence and temperament—that is, the soul—at will. A certain humility and awe must be aroused when one contemplates all the consequences of correct and detailed replies in the solution of these problems.

They are by no means completely solved. And consequently the control of soul and the control of human nature are by no means completely in our hands. But they are partially and most significantly in process of solution, with consequences on the practical side that are the veritable miracles of the age. At the same time, one should not permit oneself to be confused by the use of the phrases "physical basis of intelligence" or "physical basis of temperament," any more than one should permit oneself to be con-

fused by the phrase "physical basis of breathing." Breathing is a function of the respiratory system which consists of the lungs, the bronchial tubes, the windpipe, the larynx, the throat, the mouth, and the nose, as well as a center at the base of the brain, known as the respirating center. The whole constitutes an intricate machine, an elaborate mechanism for the intake and outgo of air. When the mechanism is functioning there is said to be breathing. Breathing cannot be thought of as existing apart from the mechanism, as, say, an overcoat can be visualized apart from the body it clothes. Similarly intelligence and temperament must be considered as mechanisms functioning, and not as entities pontificating; mechanisms involving muscles and glands of internal secretion, viscera, and the nervous system.

The chassis of the intelligence-temperament is the nervous system, that remarkable structure which is like a snake with a huge expanded head (incased in the bony box that is the skull and spine) and composed of gray matter, a gray living matter that has specialized in being irritable, in the ability to conduct its irritations, and, above all, in the ability to remember its irritations and to combine and recombine them into the substance of its experiences which is consciousness. From

this gray matter issue tentacles, long delicate filaments that weave and twist and wind their way everywhere in the body, sometimes sheathed in a white matter, to influence, to stimulate, or to depress the activities of all the cells. This serpent octopus of a creature within us is beyond a doubt the locus of intelligence-temperament.

There is a unity of effect about this serpent octopus of gray matter. But it is as a matter of fact a bipartite system, a balance of power of two parts, one of which is known as the central, animal, or newer nervous system, and the other is distinguished as the older sympathetic, autonomic, visceral, or vegetative nervous system. This bifurcation of the nervous system corresponds, in an interesting measure, to that bifurcation of the "soul," the psychic individuality or personality, into intelligence and temperament.

It is fairly well agreed among anatomists and neurologists that the seat of conscious intelligence is the cortex, the gray mantle of the brain, the portion of it generally meant when gray matter is mentioned. Human intelligence was evolved from animal intelligence and can be understood only in relation to it. The gray mantle of the brain has undergone a series of mutations in the passage from the ancestral prehuman to

modern adult human. In the process the specifically human qualities have emerged. With every step forward there has been an enlargement and thickening of the gray mantle, corresponding to an increase in the number, size, and connections of the nerve-cells.

According to Elliot Smith, the humble stock which forms the root of man's pedigree was a shrew-like creature which took to the trees millions of years ago and retained certain primitive potentialities of their gray matter, while other creatures specialized their brains along the lines of smell. The former developed, through their tree life, their senses of vision, hearing, touch, and movement, without specializing in any particular direction. In consequence there came into being the primate apes with a mechanism for the equable utilization of all the senses that paved the way for that use of symbols which is the outstanding characteristic of human intelligence. Concomitantly there has been an increasing prominence, quantitatively and qualitatively, of the frontal gray mantle, also known as the neopallium, which is present in mammals alone. Its function has been to mediate more and more skilled movements and symbols. At the same time there was a correlation of skilled movement and symbol

which resulted in a right-handedness and in gestures. Speech came as the last and greatest product of the marriage of skilled movement and symbol, and the intellectual development of man thereafter was rapid. The conception and handling of space and time are located in the frontal lobes, the most recently acquired additions to the gray mantle of the brain.

Like any machine, the workings of the gray mantle of the brain in relation to intelligence depends upon two sets of circumstances:

(1) The number, size, distribution, arrangement, and connections of the nerve-cells which compose it.

(2) And just as important is the peculiar chemistry of the cells which constitutes their functioning. This chemistry is determined in part by the food supply and in part by the chemical substances which are the internal secretions of the endocrine glands. Thyroxin, from the thyroid, and adrenalin, from the adrenals, have been shown to cause changes in the electrical conducting of the brain. After removal of the thyroid or the adrenals, the brain shows degenerative changes, and mental degeneration be-

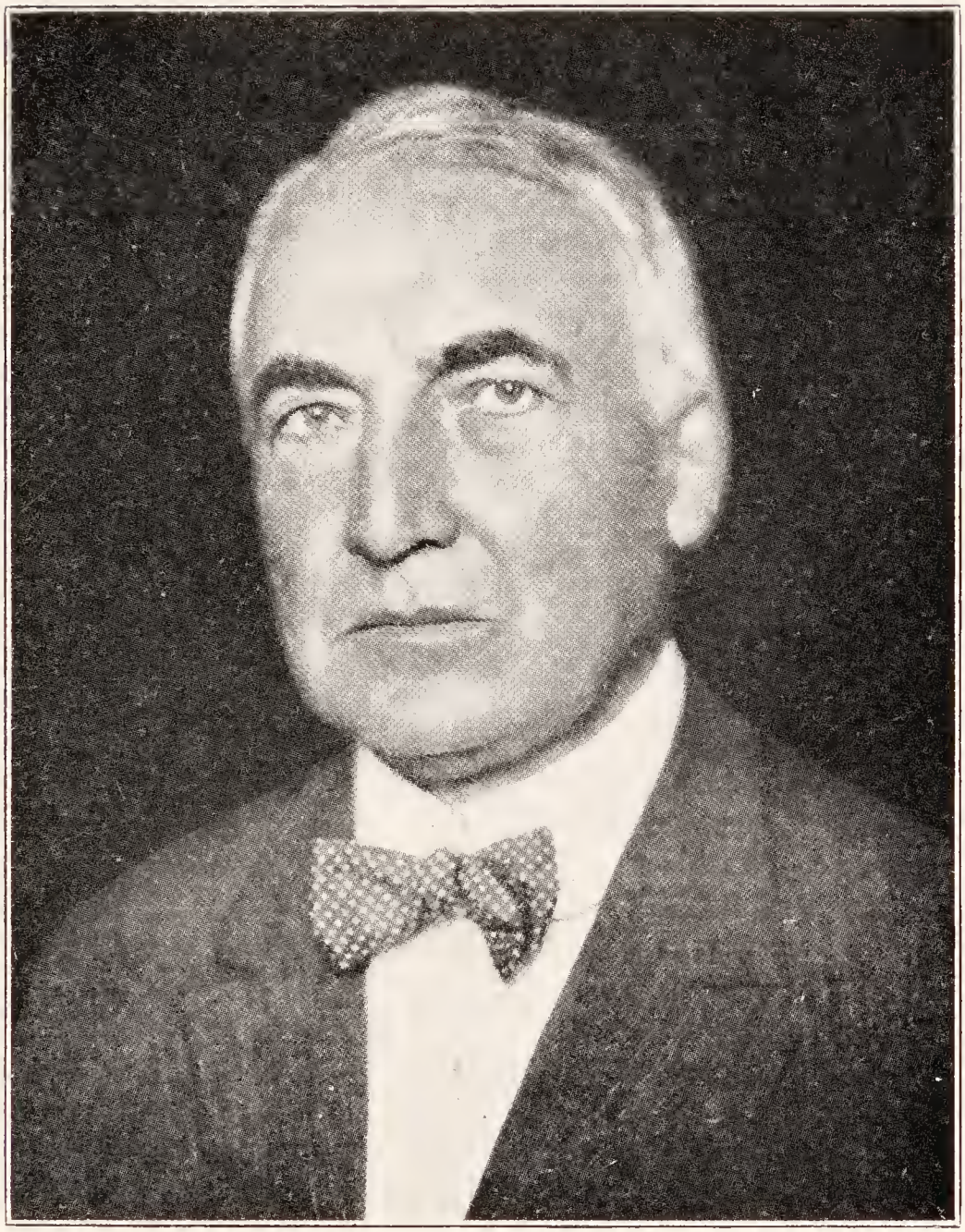
> comes evident. With congenital defects in the adrenal cortex gland, defects in the formation of the frontal gray mantle have been found. In disturbances of the pineal and thymus glands, an enlargement of the brain has been demonstrated. We must visualize the brain-cells not only structurally, but also functionally, as being continuously fed by the contents of the blood rapidly flowing through them as the gasolene and oil of the electrochemical machine which fabricates intelligence.

Within the octopus-serpent which is the nervous system is a system or chain of cells which are in communication with colonies of gray-mattered cells lying outside and alongside of the spinal column and known as the sympathetic ganglia. Besides the sympathetic ganglia, which are connected with one another like beads on a string, there are others placed nearer the viscera, such as the great solar plexus. Still others are directly embedded in the viscera, in the walls of the heart, the stomach, and so on. All these, together with the basal ganglia, larger masses of nerve cells placed beneath the gray mantle of the brain (and connected with it by two other kin-

dred areas, the midbrain and interbrain), comprise the vegetative nervous system. And the vegetative nervous system, in coöperation with the endocrine glands (the combination sometimes named the vegetative apparatus), controls temperament.

The vegetative apparatus itself is split into two divisions: one, the sympathetic, including the thyroid, adrenals, and pituitary; the other, the parasympathetic or vagus system, in close harmony with the pineal, the pancreas, and the sex glands, as well as the secreting glands of the stomach and intestines. Now, the sympathetic and parasympathetic systems are normally balanced in health, for in general their effects upon organs are antagonistic. For example, the sympathetic nerve which goes to the heart is known as the accelerator and makes it beat faster. The antagonist, the vagus nerve, on the other hand, will cause it to beat more slowly or to stop beating altogether.

When the balance is upset for one reason or another, a curious law, important for the consideration of temperament, appears. When the balance is upset in favor of the sympathetic, the individual is activated for fight or flight in a given situation. When the balance is disturbed



WARREN GAMALIEL HARDING

Presenting the salient characteristics of an adrenal-centered type

in favor of the parasympathetic, the result tends toward comfort and contentment.

When the sympathetic system dominates, either with intense excitement or because of an injection of adrenalin, the pupil dilates to increase the field of vision, the heart beats faster to send the blood around more quickly, breathing becomes more rapid, the sweat-glands and oil-glands secrete their fluids to make the body more greasy and slippery, the hairs are erected to make the aspect more terrifying. All makes for assistance in fight or flight.

In contrast, when the parasympathetic dominates, reverse effects occur. The pupil contracts to shield the retina from excessive light; the heart slows, augmenting the period of diastole when the heart recuperates, and furthering the emptying of organs, thus relieving them of tension. In general, the sympathetic facilitates the consumption of energy; the parasympathetic, its production and storage.

Now, in any emotion, fear, joy, rage, disgust, there occurs an upset of equilibrium in the vegetative apparatus. Emotions, in fact, are the registration in consciousness, accompanied by a specific feeling-tone, of a chain of interlocking

events, reflexes in the vegetative apparatus. The balance between its sympathetic and parasympathetic divisions is then always upset. And energy is discharged until equilibrium between them, or exhaustion, ensues.

Emotional reflexes or changes in the vegetative apparatus produce five types of results:

(1) Changes in the striated or voluntary musculature, such as those of the arms and hands, the legs and feet.

(2) Changes in the non-striated, involuntary, or smooth muscles, such as those which contract the stomach, the intestines, the bladder, the bronchial tubes.

(3) Changes in the glands of external secretion, the exocrine glands as the salivary glands of the mouth, which may cause it to water at the sight of food, the stomach glands, which secrete hydrochloric acid and pepsin in varying amounts in states of emotion, the kidneys which will oversecrete at times of mental stress or anxiety as at examinations, when sugar may also occur in the urine.

(4) Changes in the glands of internal secretions, the endocrine glands.

(5) Changes in the blood.

To coördinate these five sets of changes in the vegetative apparatus, executive central stations must exist. Their existence has been established in the older structures at the base of the brain which are parts of the vegetative apparatus. Disturbance or destruction of the cells in these basal ganglia produces breaks in the mechanics of the emotions. There is no space here to consider the great mass of evidence that delivers this conclusion. It may be mentioned that a series of studies of the effects of the disease of lethargic encephalitis, the sleeping sickness, have contributed materially to our knowledge. Pathology of the basal ganglia has produced changes in the power to attend and concentrate and in memory, judgment, and imagination in so far as they are related to creative emotion and mimicry.

It is upon these nerve-centers that the internal secretions may be assumed to act directly, by determining the state of excitability of the cells as well as indirectly by the changes they effect in the blood, the viscera, and the muscles. A substance like pituitrin has been isolated from them. And it may be that one of the functions of pituitrin is to keep them properly tuned. For in the diseases which destroy the pituitary gland, the emotional apathy and indifference is striking.

The conception of the "subconscious" was called by William James the greatest contribution of the nineteenth century in psychology. The relations of temperament and the subconscious must necessarily be of the most intimate. While it is pretty generally agreed that the gray mantle of the great brain is the seat of the conscious, only speculations are at our disposal concerning the subconscious. Nevertheless there are certain data in favor of the following view, which is offered for what it is worth in the way of deductions for experiments by those to whom it may appeal.

The organism as a whole, or the personality as a whole, has to deal with two worlds, the world without and the world within, and to make the best of them. "Environment" is the word most used to cover the world without. And the gray mantle of the great brain is the organ evolved to obtain and register the greatest amount of information possible concerning the world without and how to deal with it.

But there is also a world within the individual which the great brain must take account of, which is indeed its fundamental concern. This world consists of the millions of cells not a part of the great brain but constituting the great cor-

poration of the body. They form tissues and organs, muscles, bones, blood, glands, viscera. Each cell is a unit, each tissue is a unit, each organ is a unit. Changes for good or bad are continually going on in them. These changes must somehow be coördinated, and an awareness of them somehow communicated to some central station.

It would seem that the most primitive organism was most concerned about what was going on within itself rather than in what was going on around it. An acute awareness of internal maladjustment was a necessity, because, after all, what the external environment always produced was some mutation of conditions within. The sympathetic nervous system and the basal ganglia developed primarily for awareness and for following up the coördination of events in the interior.

The consciousness of the lowest organisms, then, according to this conception, would be quite different from the consciousness of an active higher animal like man. It would consist of sharp, bright, vivid sensations and feeling-tones conveyed from the tissues and organs, fused and blended, focusing upon the heart, the stomach, the liver, or kidneys, as the stream of energy

from one or the other became more interesting.

The outside of the animal, the conventional environment, was a vague, surrounding, occasionally disturbing atmosphere, which supplied nutrients and sometimes became as acutely troublesome and attention-compelling as, say, acute colic due to a stone in the kidney may become to a normally extroverted man. The stuff of keen awareness, in other words, was visceral and possessed a continuous poignancy that our consciousness has only at times of emotional stress. And memories piled up of these visceral sensations. The consciousness of a worm may be something of the sort.

As organisms evolved, become more complex, active, adventurous, aggressive, with the evolution of the sense-organs or receptors to react quickly and subtly to the much more varied and multitudinous contents of the external environment, and the value of remembering experiences from them became dominant, there was bound to emerge a competition, a conflict between the two types of awareness, two kinds of consciousness, one of what was going on inside, the other of what was going on outside. Out of islands of nerve-cells originally separated and in relation only to the sense-organs and alimentary tract, the

important surface of contact between the outside and the inside, a new nervous system was created which flowered in the gray mantle of what was to become the great brain, greatest in man, making him, if not the happiest, certainly the most efficient of animals.

Natural selection must then have decided in favor of the newer extroverted consciousness as against the older introverted. The attending selector of the new consciousness became *the* consciousness. The older, however, remained subservient, but, as it were, hovering at the wings of the other, meanwhile carrying on its old business of sensing and registering and coördinating internal visceral changes, keeping the new-comer barely in touch with these changes, except at times of marked sudden, intense, or overwhelming mutation of conditions which leads to the kind of awareness recognized as an emotion.

According to this hypothesis, we are all of us compounds of at least two personalities, two forms of awareness: one, of ourselves; and the other, of the environment. One is the conscious, the functioning of the newer, more extroverted, environmental nervous system; the other, the subconscious, represents the older, more introverted, visceral nervous system. In the association of

the two, particularly in the association of emotional memories with the memories of things and persons, most important consequences for the personality occur. The so-called conditioned reflex and conditioned conduct appear. It has been demonstrated that there are areas in the basal ganglia and the midbrain which when damaged will be followed by changes in the viscera, such as the liver, the thyroid, the adrenals, as well as changes in the chemistry of the blood, such as its content of sugar or uric acid.

Temperament, then, reflects the history, past as well as contemporary, of the vegetative nervous system and the vegetative apparatus; in other words, the subconscious. Intelligence mirrors the history, past as well as contemporary, of the animal nervous system, particularly of the gray mantle of the brain; in other words, the conscious. No sharp cleavage, however, should be made between them, since they continually interact, and the metabolism of the gray mantle, the cerebral cortex, varies from day to day, indeed, from hour to hour, with changes in the vegetative apparatus, and in particular the glands of internal secretion.

The influence of the glands of internal secretion upon intelligence and temperament is of the

greatest importance because, apart from suggestion and education, they are the most practical means of influencing them at our command today. Their effects are more profound than those of suggestion (in which the vegetative nervous system is affected) and of education (in which the animal nervous system is affected) because they act upon the roots of both the chemical constituents and the reactions of the cells. To Hippocrates and Galen temperament was a matter merely of different mixtures of the four "humors," blood, black bile, yellow bile, and phlegm. They were not, however, able to effect any changes of personality by means of their "humors." By means of the internal secretions, though, profound modifications of the body-mind may be achieved which envisaged are the most convincing evidence of their influence, as the following examples illustrate:

(1) A boy of twelve, very much alive, acute and bright until his twelfth year. Up to this time was easily among the first in his class and a leader in athletics. General disposition was happy, cheerful, and imaginative. Then in his twelfth year he became lazy, fell behind in his studies, increased rapidly in weight, put-

ting on fat, seemed to lose any imagination or initiative he ever had, became dull and inert, and indeed in all outward appearances suggested a moron. He showed a number of the stigmata of subthyroidism developing upon a basis of hyperthyroidism and, after his thyroid was treated for six months, was restored to his former self.

(2) A boy of eight up to the age of seven had been a dark, husky, healthy, average boy, rather more fond of outdoors than his studies. He was then infected with diphtheria, which seemed to respond quickly to diphtheria antitoxin. But since then he seems to have become afraid to mix with other boys. Even when an opponent was smaller, he exhibited fear and violent trembling with the slightest show of aggression. He was nervous and timid in school, which had been changed three times. He showed a low blood-sugar and blood-pressure. He was put on adrenal cortex and in about a year was completely transformed.

(3) A boy of eleven, small-boned, under-sized,

thin, with the general look of a weakling. All his life he had been a pathological liar and fabricator, concocting stories of the most preposterous kind to explain his lying and stealing. His mother had typhoid fever while carrying him. He was emotionally unstable, extremely sensitive to pain, and subject to paroxysms of temper. These traits had been present from earliest childhood and had persisted, in spite of various psychological methods of treatment attempted by training, suggestion, education, and punishment. Examination showed basic pituitary deficiency, particularly of the anterior gland. Pituitary therapy after two years showed such a marked transformation physically, mentally, and morally that some of the boy's former teachers talked of exhibiting him before a society of teachers and educators interested in the subject.

(4) Boy of thirteen, whose mother brought him because, although superficially normal, yet he did not attain her own standards. The mother herself was subthyroid and had a goiter. The boy, ten

years old, of average height and weight, was much interested in sports and had won several medals and cups in competitive games. His memory, both at home and in school, however, was quite poor. In school he had particular trouble with arithmetic and spelling. He was obedient in school but not at home, where he was irritable and aggressive. In school he was a good mixer and a "good sport." He was very fond of meat but did not care for fats or sweets. His muscle development was good but his muscles tended to be twitchy under excitement. Examination showed a hyperirritability of the peripheral nerves, and the blood chemistry showed a diminished lime content. These, together with other signs, made for the diagnosis of parathyroid insufficiency, with marked improvement, in the course of a year, of his nervousness and psychic defects.

(5) A woman of thirty-two presented evidence of belonging to the intermediate sex, with masculinity increasing in past five years. Her shoulders were broader than her waist; the feet and ankles were

large; the general body build suggested the masculine adolescent ("boyish lines"). Lately, the skin, always unattractive, had become coarser, the pores larger, and the texture thicker. She was somewhat attracted by men (her menstrual periods were regular although very painful), but her friendships for women were deeper, tending to take on a depth that sometimes startled the friends and caused precipitous quarrels and fracture of friendship. There were numerous signs of ovarian and thyroid deficiency with pituitary and adrenal compensation.

(6) A young woman of seventeen, who had not yet begun to menstruate regularly, was undersize and showed delayed development of normal girl psychology—interest in boys and sex matters. She weighed ten pounds at birth, was overweight at birth in other words, but the mother's milk did not agree with her, and she became emaciated so that at one year she weighed what she weighed at birth. Her development was delayed all along the line: she had only two teeth

at one year, did not walk until two years, and did not talk distinctly for a long time. There was apparently no suggestion of rickets, but she was two years behind in her general dimensions all through childhood, in sizes of clothing and so on. Her weight was good for her height after seven; she grew gradually until thirteen, when there was a spurt of growth, which then ceased. In school she was liked and received the praise of teachers in literature and art but was very poor in arithmetic. She liked and was rather good at drawing faces and figures. She was always imaginative and fond of reading adventure and mystery stories, but did not care for romances or love-stories. She had no musical tendency or faculty. She liked to dance, but not with boys. She went to dances but did not seem "to get a crush on any of the boys" like the other girls in her class. She loved sweets. The physical examination showed disproportionate relation of the torso and limbs, the skin of the forehead and cheeks coarse, dry, and pimply, the hair

mouse-colored and dandruff-producing, and the blood-pressure low. After ovarian treatment for about ten months, her father, an eminent New England engineer, was able to write as follows: "... is in fine condition physically and mentally. Her menstruations are regular, she feels strong, her skin is clear, never gets tired in school any more, has become very fond of boys and is a very different girl from what she was ten months ago."

These are a few examples of definite changes in personality in general, but particularly in temperament and intelligence reaction, as a result of modifying the endocrine make-up of an individual by various procedures. There are a great number of similar achievements reported in the literature of the subject. It is when one views these results as concrete instances of the effect of chemical products, synthesized within the body, upon its nervous system, animal and vegetative, that one is most impressed and convinced of the dominating influence of the endocrine glands upon intelligence and temperament.

An enormous amount of work remains to be done in correlating various psychologic tests of

intelligence and temperament with endocrine constitution and reactions. A number of contemporary researches are concentrating upon the subject. One great field that is just beginning to be explored is that of modification of animal behavior and instincts, studied under fixed conditions, by feeding glandular extracts or interfering with glandular functioning by one of several methods.

Take, for example, the matter of the interpretation of handwriting as an index of character, intelligence, and temperament. As much hokum has been talked and published concerning handwriting as concerning the impossible horoscopes which pretend to diagnose character and fate from the position of the planets and stars at one's birth, or the lines in the palm of the hand. But some authentic data are available.

Although a treatise on the reading of character from handwriting was first published by Camillo Baldo, an Italian, in 1662, and was followed by a host of successors who won converts among men like Sir Walter Scott, Leibnitz, and Goethe, and the most exaggerated claims were made by various self-styled experts, it was not until the original genius of Alfred Binet—who created the intelligence tests, the complete reverberations of

which the modern world has yet to see—made the first serious attempt to study them by scientific methods that some trustworthy information was obtained. In his charming "Revelations of Handwriting" he published his results. In one experiment he had 180 envelopes addressed by about an equal number of men and women. Then he had the professional experts, amateurs and wholly untrained individuals, record their guesses. The most celebrated professional, Crépieux-Jamin, had 79 per cent right, while a novice had 73 per cent. In a second experiment, the handwriting of thirty-seven eminent intellectuals, such as Renan and Bergson, was paired with the writing of persons of similar education and social standing. The conclusion was that intelligence showed in the handwriting, but no great distinction was possible between ordinary intelligence and great intelligence. In a third experiment, Binet secured the handwriting of eleven notorious criminals, and with these paired eleven honest, respected bourgeois. Crépieux-Jamin read 73 per cent correctly. Two other professionals detected only six out of the eleven criminals.

Hall and Montgomery studied seventeen students of the University of Wisconsin to test the

validity of traditionally accepted signs of handwriting and character. That ambition is indicated by the lines of the writing tending to slope upward, that pride writes likewise, that bashfulness is revealed by minute and fine handwriting, that force speaks in heavy lines, with heavy crossings of the t's, that perseverance is signified by long bars on the t's, and reserve by closed a's and o's—these were the ideas tested. Their conclusions were that there was no tendency whatever for an ambitious person to write in an upward, slanting direction, and no evidence for any of the other rules.

Professor June Downey has constructed a series of tests of temperament and character qualities such as assurance, speed of decision, speed of movement, care for detail, by observing and charting the handwriting as a *definite form of behavior* and subjecting it to various conditions. Thus the subject is asked to write "United States of America" as he would ordinarily, then as rapidly as possible, then as slowly as possible, then in a disguised hand, then with eyes closed, and so on. Conclusions are then charted by using a standard of ten points and marking for each character quality as correlated with the form of behavior expressed in the

changed handwriting. This is known as the Will Profile. In the study of a large number of profiles, various types appear. To quote: "It is also tempting, although no doubt highly speculative, to try to associate the will-temperament types with glandular formulas. The speedy, impulsive individual would be identified as the thyroid type. With control and endurance added we would have the thyroid-adrenal. The deliberate, slow, careful type suggests Berman's antepituitary type."

Temperament is a matter of the history of energy in the personality as expressed through the nervous system. The Downey temperamental tests are fundamentally tests of various properties of the energy flow in the individual. These —speed, force, and endurance, comparable to the voltage, amperage and the power to overcome resistance, of an electric current—are qualities that are definitely to be correlated with the functioning of the thyroid, adrenal, and pituitary glands respectively. In disturbed states of these glands, nothing is more patent than the slowing of the thyroid-deficient individual as contrasted with the quick, mobile reactions of the hyperthyroid, or the weakening of the adrenal diseased as contrasted with the strength and

vigor of the adrenal-adequate people; and the lack of endurance, the low stamina, and resisting power of the pituitary-poor individual contrasts with the perseverance and reserve power of the hyperpituitary types.

Much remains to be learned concerning the influence of the internal secretions on the emotional centers of the brain. But the work of Maranon points rather distinctly to an emotion-mobilizing effect of adrenalin when injected into an individual previously sensitized by thyroid extract or already hyperthyroid or in individuals suffering from adrenalin deficiency. There are two types of recation, the "cold" reaction, or the "hot" reaction. In the "cold" reaction, the individual perceives, about fifteen minutes after the injection, bodily changes accompanying an emotion, without the specific emotion itself. He is a spectator rather than a participant in the proceedings. He is conscious of such effects as internal tremor, tremor of the limbs, cold hands, parched mouth, palpitation of the heart, shedding of tears, and so on. The individual may say, either upon being questioned or without being questioned, "I feel as if somebody were going to hurt me," or, "I feel as if were going to weep without knowing why," or, "I feel as if I were

greatly afraid, yet I am calm.'' In the ''hot'' reaction, there is not only a perception of the bodily changes accompanying emotion, but there also appears, suddenly or gradually, a true emotional outburst, often concomitantly with sighing, sobbing, or weeping. Another pertinent by-effect consists in the following: The individual when asked questions about absent or dead relatives would show no signs of emotion before the injection. But after the injection the same questions would elicit an outburst of weeping or sobbing.

''The personal equation'' is a phrase that was first invented in the eighteenth century in relation to errors in astronomical observations. It was first applied to the mistakes of a Greenwich astronomer named Kinnebrook. It was found that his observations diverged from the calculated values by a more or less constant quantity. It became recognized that two observers, each of admitted skill, often differ in their record of the same event—as the passage of a star before the wires of a transit instrument—by quantity nearly the same for all observations by the same person. This quantity could therefore be introduced into mathematical equations to check and control er-

rors made by them. And indeed machines have been invented for determining the amount of the personal equation by reproducing artificially the conditions and kind of observation usually affected by this form of error. By transfer of the general meaning of the term the phrase came to be applied to all those individual peculiarities and idiosyncrasies which have to be taken into account in estimating the personality.

To-day the personal equation may be said to have been analyzed into two sets of factors: first, the inherited chromosome factors; and, second, the glandular or endocrine factors which are most susceptible to the environment.

It has been definitely established among the invertebrates like the fruit-fly that the chromosomal constituents, more or less independently of the environment (although even here the necessity of a standard environment, so called, has been conceded), are the fundamental determiners of individual characteristics. Apparently this is because among the invertebrates the reactions are totally determined by the substances in the chromosomes and diktosomes. Among the vertebrates, however, another apparatus becomes evolved. This apparatus is the system of the endocrine glands. The significant fact should be

stressed that it is only among the vertebrates that the glands of internal scretion begin to exert an important influence upon the local and general metabolisms. Among the invertebrates most of them do not exist, or only their homologues have been demonstrated. Moreover, the glands themselves undergo an evolution as one ascends the vertebrate scale, an evolution which points to an increasing influence upon individuality. No parathyroid glands have been found in fishes. In amphioxus the thyroid is a saccular organ which opens into the pharynx, and is lined by ciliated epithelium which secretes mucus. According to Vincent, nothing corresponding to the adrenals has so far been discovered in amphioxus. And there is a well-known difference between the effects of extirpations of the sex-organs in invertebrates and in vertebrates. In invertebrates, as, for example, certain butterflies, extirpation of the reproductive organs either experimentally or by disease is not accompanied by any change in the organism as a whole. In other words, there are no metabolic repercussions of the loss. In vertebrates the general bodily and mental effects of such an experiment are well known.

This last example may indeed be taken to ex-

emplify the complete principle involved. In the invertebrates the inherited substances alone determine the architecture of the individual. In the vertebrates their influence become indissolubly linked with the action of organs which they themselves create, but which have in turn a modifying effect upon them. In the vertebrates, in fact, it may be stated that the inherited substances determine the production of local tissues and local tissue tendencies. The endocrine substances act either to exaggerate and stimulate or depress and inhibit these local tissue tendencies. From this point of view the chromosomes may be said to be local or regional factors; the endocrines may be contrasted as the constitutional or distributive factors. Two general laws may be deduced from the existing mass of evidence which for lack of space cannot be detailed here, concerning the relations of the chromosomal or regional and the constitutional or endocrine factors:

1. The internal secretions are chemical substances influencing (specifically as stimulants or depressants, in other words as accelerators or retarders) local tendencies in cells, tissues, and organs dependent upon local chemical reactions and physicochemical conditions.

2. These influences and relations are specific:

that is, the character or intensity of effect depends upon a particular specificity in the relation of the internal secretion and the chemical substances in the region under consideration, neither of which can be completely replaced by any other substance.

Viewing individuals as the outcome of the specific interactions of these two sets of factors, the important principle emerges that whereas the inherited local factors are more or less independent of the environment and possessed of, as it were, a tremendous dynamic inertia of their own, the endocrine glands are indeed the mediators between the organism and the environment: both developmentally and in maturity, they play a most significant modifying and correlating rôle. By their interactions they produce that magnificent anthology of personalities which is the chief fascination of life.